МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ОДЕСЬКИЙ ДЕРЖАВНИЙ ЕКОЛОГІЧНИЙ УНІВЕРСИТЕТ

МЕТОДИЧНІ ВКАЗІВКИ
для СРС та навчальний матеріал
з англійської мови для студентів IV курсу
денної форми навчання

Спеціальність: «Науки про Землю»

Одеса - 2019

Методичні вказівки для СРС та навчальний матеріал з англійської мови для студентів IIV курсу денної форми навчання.
Спеціальність: «Науки про Землю ».

Укладач: ст. викладач Баєва В.М. - Одеса: ОДЕКУ, 2019. – 114 с.

ПЕРЕДМОВА

Методичні вказівки для СРС та навчальний матеріал з англійської мови призначені для студентів ***IV курсу*** денної форми навчання зі спеціальності «Науки про Землю».

Мета запропонованих методичних вказівок — розвинути навички читання, аналізу, перекладу текстів, а також їх переказу на матеріалі наукової літератури за фахом.

Методичні вказівки складаються з 4 уроків, де подано відповідний граматичний матеріал за програмою, а також тексти, що відібрані з оригінальної науково-популярної та наукової літератури.

Тексти A та B призначені для аудиторній роботи студентів: для читання, усного перекладу, аналізу елементів тексту, анотування та переказу; ***тексти C та D*** тематично пов'язані з текстами А та В, призначені для СРС та тематично-письмового перекладу з подальшою перевіркою на занятті, уточненням значень окремих лексичних одиниць та переказу.

Лексичні вправи призначені для вивчення та закріплення лексичного матеріалу кожного уроку та охоплюють лексику основних текстів. Вони можуть бути використані також для контролю (самоконтролю) засвоєння лексичного матеріалу уроку. Під час виконання лексичних вправ рекомендується не тільки підбирати українські або англійські еквіваленти наведених слів та словосполучень, але й знаходити у тексті або складати самостійні речення з зазначеними словами, звертаючи увагу на багатозначність слів.

Граматичні вправи спрямовані на аналіз найскладніших граматичних явищ англійської мови, розвиток навичок орієнтування у граматичній структурі англійського речення, що сприяє вірній інтерпретації текстів, української мови та матеріалів наукової літератури.

Після вивчення даного курсу студенти повинні знати і вміти:

читати та перекладати науково-технічну англомовну літературу за фахом для отримання необхідної інформації;

розуміти зміст прочитаного та лексико-граматичний матеріал, наданий у методичних вказівках;

розуміти і володіти відповідними граматичними конструкціями та матеріалом;

брати участь в усному спілкуванні англійською мовою в обсязі матеріалу, передбаченого програмою.

INTRODUCTION

THE IMPORTANCE OF EARTH SCIENCE

Today we live in a time when the Earth and its inhabitants face many challenges. Our climate is changing and that change is being caused by human activity. Earth scientists recognized this problem and will play a key role in efforts to resolve it. We are also challenged to: develop new sources of energy that will have minimal impact on climate; locate new sources of metals and other mineral resources as known sources are depleted; and, determine how Earth's increasing population can live and avoid serious threats such as volcanic activity, earthquakes, landslides, floods and more. These are just a few of the problems where solutions depend upon a deep understanding of Earth science.

Earth science

Earth science or geoscience is an all-embracing term for the fields of science related to the planet Earth. It can be considered to be a branch of planetary science, but with a much older history. There are both reductionist and holistic approaches to Earth sciences. The Earth sciences can include the study of geology, the lithosphere, and the large-scale structure of the Earth's interior, as well as the atmosphere, hydrosphere, and biosphere. Typically, Earth scientists use tools from geography, physics, chemistry, biology, chronology, and mathematics to build a quantitative understanding of how the Earth system works and evolves.

Physical geography, covers aspects of geomorphology, soil study, hydrology, meteorology, climatology, and biogeography.

Geology describes the rocky parts of the Earth's crust (or lithosphere) and its historic development. Major subdisciplines are mineralogy and petrology, geochemistry, geomorphology, paleontology, stratigraphy, structural geology, engineering geology, and sedimentology.

Geophysics and geodesy investigate the shape of the Earth, its reaction to forces and its magnetic and gravity fields. Geophysicists explore the Earth's core and mantle as well as the tectonic and seismic activity of the lithosphere. Geophysics is commonly used to supplement the work of geologists in developing a comprehensive understanding of crustal geology, particularly in mineral and petroleum exploration.

Soil science covers the outermost layer of the Earth's crust that is subject to soil formation processes (or pedosphere). Major subdisciplines include edaphology and pedology.

Ecology covers the interactions between the biota, with their natural environment. This field of study differentiates the study of the Earth, from the study of other planets in the Solar System; the Earth being the only planet teeming with life.

Hydrology (includes oceanography and limnology) describe the marine and freshwater domains of the watery parts of the Earth (or hydrosphere). Major subdisciplines include hydrogeology and physical, chemical, and biological oceanography.

Glaciology covers the icy parts of the Earth (or cryosphere).

Atmospheric sciences cover the gaseous parts of the Earth (or atmosphere) between the surface and the exosphere (about 1000 km). Major subdisciplines include meteorology, climatology, atmospheric chemistry, and atmospheric physics.

Overview of Earth Science

Earth is the mighty planet upon which we all live. Only recently have humans begun to understand the complexity of this planet. In fact, it was only a few hundred years ago that we discovered that Earth was just a tiny part of an enormous galaxy, which in turn is a small part of an even greater universe. Earth Science deals with any and all aspects of the Earth. Our Earth has molten lava, icy mountain peaks, steep canyons and towering waterfalls. Earth scientists study the atmosphere high above us as well as the planet's core far beneath us. Earth scientists study parts of the Earth as big as continents and as small as the tiniest atom. In all its wonder, Earth scientists seek to understand the beautiful sphere on which we thrive.

Because the Earth is so large and science is so complex, Earth scientists specialize in studying just a small aspect of our Earth. Since all of the branches are connected together, specialists work together to answer complicated questions. Let's look at some important branches of Earth Science.

Geology

Geology is the study of the solid matter that makes up Earth. Anything that is solid, like rocks, minerals, mountains, and canyons is part of geology. Geologists study the way that these objects formed, their composition, how they interact with one another, how they erode, and how humans can use them. Geology has so many branches that most geologists become specialists in one area. For example, a mineralogist studies the composition and structure of minerals such as halite (rock salt), quartz, calcite, and magnetite.

A volcanologist braves the high temperatures and molten lava of volcanoes. Seismologists study earthquakes and the forces of the Earth that create them. Seismologists monitor earthquakes worldwide to help protect people and property from harm. Scientists interested in fossils are paleontologists, while scientists who compare other planets' geologies to that of the Earth are called planetary geologists. There are geologists who only study the Moon. Some geologists look for petroleum, others are specialists on soil. Geochronologists study how old rocks are and determine how different rock layers formed. There are so many specialties in geology that there is probably an expert in almost anything you can think of related to the Earth.

Oceanography

Oceanography is the study of everything in the ocean environment. More than 70% of the Earth's surface is covered with water. Most of that water is found in the oceans. Recent technology has allowed us to go to the deepest parts of the ocean, yet much of the ocean remains truly unexplored. Some people call the ocean the last frontier. But it is a frontier already deeply influence by human activity. As the human population gets even bigger, we are affecting the ocean in many ways. Populations of fish and other marine species have plummeted because of overfishing; contaminants are polluting the waters, and global warming caused by greenhouse gases is melting the thick ice caps. As ocean waters warm, the water expands and, along with the melting ice caps, causes sea levels to rise.

Climatologists help us understand the climate and how it will change in the future in response to global warming. Oceanographers study the vast seas and help us to understand all that happens in the water world. As with geology, there are many branches of oceanography. Physical oceanography is the study of the processes in the ocean itself, like waves and ocean currents. Marine geology uses geology to study ocean earthquakes, mountains, and trenches. Chemical oceanography studies the natural elements in ocean water and pollutants.

Climatology and Meteorology

Meteorology is the study of the atmosphere and how processes in the atmosphere determine. Earth’s weather and climate. Meteorology is a very practical science because everyone is concerned about the weather. How climate changes over time in response to the actions of people is a topic of urgent worldwide concern. The study of meteorology is of critical concern for protecting Earth’s environment.

Perhaps this branch of Earth Science is strangely named but it is very important to living creatures like humans. Meteorology includes the study of weather patterns, clouds, hurricanes, and tornadoes. Using modern technology like radars and satellites, meteorologists work to predict or forecast the weather. Because of more accurate forecasting techniques, meteorologists can help us to prepare for major storms, as well as help us know when we should go on picnics.

Climatologists and other atmospheric scientists study the whole atmosphere, which is a thin layer of gas that surrounds the Earth. Most of it is within about 10 - 11 kilometers of the Earth’s surface. Earth’s atmosphere is denser than Mars’s thin atmosphere, where the average temperature is -63° C, and not as thick as the dense atmosphere on Venus, where carbon dioxide in the atmosphere makes it hot and sulfuric acid rains in the upper atmosphere. The atmosphere on Earth is just dense enough to even out differences in temperature from the equator to the poles, and contains enough oxygen for animals to breathe.

Over the last several decades, climatologists studying the gases in our atmosphere have found that humans are putting a dangerous amount of carbon dioxide into the air by burning fossil fuels. Normally, the atmosphere contains only small amounts of carbon dioxide, and too much of it makes it trap heat from the sun, causing the Earth to heat up, an effect we call global warming.

Climatologists can help us better understand the climate and how it may change in the future in response to different amounts of greenhouse gases and other factors.

Astronomy

Astronomers have proven that our Earth and solar system are not the only set of planets in the universe. By 2007, over a hundred planets outside our solar system had been discovered. Although no one can be sure how many there are, astronomers estimate that there are billions of other planets. In addition, the universe contains black holes, other galaxies, asteroids, comets, and nebula. As big as Earth seems to us, the entire universe is vastly greater. Our Earth is an infinitesimally small part of our universe.

Astronomers use resources on the Earth to study physical things beyond the Earth. They use a variety of instruments like optical telescopes and radio telescopes to see things far beyond what the human eye can see. Spacecraft travel great distances in space to send us information on faraway places, while telescopes in orbit observe astronomical bodies from the darkness of space.

Astronomers ask a wide variety of questions. Astronomers could study how an object or energy outside of Earth could affect us. An impact from an asteroid could have terrible effects for life on Earth. Strong bursts of energy from the sun, called solar flares, can knock out a power grid or disturb radio, television or cell phone communications. But astronomers ask bigger questions too. How was the universe created? Are there other planets on which we might live? Are there resources that we could use? Is there other life out there? Astronomy also relies on Earth Science, when scientists compare what we know about life on Earth to the chances of finding life beyond this planet.

Other Branches of Earth Science

Geology, oceanography, and meteorology represent a large part of Earth science, while astronomy represents science beyond Earth. However, there are still many smaller branches of science that deal with the Earth or interact greatly with Earth sciences. Most branches of science are connected with other branches of science in some way or another.

Below are examples of a few branches of science that are directly related to Earth science. Environmental scientists study the ways that humans interact with the Earth and the effects of that interaction. We hope to find better ways of sustaining the environment. Biogeography is a branch of science that investigates changes in populations of organisms in relation to place over time. These scientists attempt to explain the causes of species' movement in history. Ecologists focus on ecosystems, the complex relationship of all life forms and the environment in a given place. They try to predict the chain reactions that could occur when one part of the ecosystem is disrupted.

None of these scientific endeavors would be possible without geographers who explore the features of the surface and work with cartographers, who make maps. Stratigraphy is another area of Earth science which examines layers of rock

beneath the surface. This helps us to understand the geological history of the Earth. There is a branch of science for every interest and each is related to the others.

Today the Earth sciences are divided into many disciplines, which are themselves divisible into six groups:

Those subjects that deal with the water and air at or above the solid surface of the Earth. These include the study of the water on and within the ground (hydrology), the glaciers and ice caps (glaciology), the oceans (oceanography), the atmosphere and its phenomena (meteorology), and the world's climates (climatology). In this article such fields of study are grouped under the hydrologic and atmospheric sciences and are treated separately from the geologic sciences, which focus on the solid Earth.

Disciplines concerned with the physical-chemical makeup of the solid Earth, which include the study of minerals (mineralogy), the three main groups of rocks (igneous, sedimentary, and metamorphic petrology), the chemistry of rocks (geochemistry), the structures in rocks (structural geology), and the physical properties of rocks at the Earth's surface and in its interior (geophysics).

The study of landforms (geomorphology), which is concerned with the description of the features of the present terrestrial surface and an analysis of the processes that gave rise to them.

Disciplines concerned with the geologic history of the Earth, including the study of fossils and the fossil record (paleontology), the development of sedimentary strata deposited typically over millions of years (stratigraphy), and the isotopic chemistry and age dating of rocks (geochronology).

Applied Earth sciences dealing with current practical applications beneficial to society. These include the study of fossil fuels (oil, natural gas, and coal); oil reservoirs; mineral deposits; geothermal energy for electricity and heating; the structure and composition of bedrock for the location of bridges, nuclear reactors, roads, dams, and skyscrapers and other buildings; hazards involving rock and mud avalanches, volcanic eruptions, earthquakes, and the collapse of tunnels; and coastal, cliff, and soil erosion.

The study of the rock record on the Moon and the planets and their satellites (astrogeology). This field includes the investigation of relevant terrestrial features—namely, tektites (glassy objects resulting from meteorite impacts) and astroblemes (meteorite craters).

With such intergradation boundaries between the divisions of the Earth sciences (which, on a broader scale, also intergrade with physics, chemistry, biology, mathematics, and certain branches of engineering), researchers today must be versatile in their approach to problems. Hence, an important aspect of training within the Earth sciences is an appreciation of their multidisciplinary nature.

Answer the questions:

1. What is the importance of Earth science education?
2. Why do we study Earth sciences?

3. Why is teaching Earth science important?
4. Why should I study Earth science?
5. Is Earth science more important than other branches of science?
6. What are some important functions of Earth science?
7. What is the importance of Earth science and life science to humanity?
8. How are Earth and life science related?
9. How does Earth science affect your life?
10. Why was the “Earth” named Earth. Who named it? How have the planets been named?

LESSON 1

METEOROLOGY

Answer the questions:

1. Will climate change really be the end of the world like some people are saying?
2. Is climate change actually real or are governments using the idea to generate millions of dollars?
3. Can people adopt to a much warmer climate on Earth?
4. Why do people speak of "global warming" when they really mean climate change?

Text A

An **atmosphere** (from Modern Greek ἀτμός *(atmos)*, meaning 'vapour', and σφαῖρα *(sphaira)*, meaning-sphere) is a layer or a set of layers of gases surrounding a planet or other material body, that is held in place by the gravity of that body. An atmosphere is more likely to be retained if the gravity it is subject to is high and the temperature of the atmosphere is low.

The atmosphere of Earth is composed of nitrogen (about 78%), oxygen (about 21%), argon (about 0.9%), carbon dioxide (0.04%) and other gases in trace amounts. Oxygen is used by most organisms for respiration; nitrogen is fixed by bacteria and lightning to produce ammoniaused in the construction of nucleotides and amino acids; and carbon dioxide is used by plants, algae and cyanobacteria for photosynthesis. The atmosphere helps to protect living organisms from genetic damage by solar ultraviolet radiation, solar wind and cosmic rays. The current composition of the Earth's atmosphere is the product of billions of years of biochemical modification of the paleoatmosphere by living organisms.

The term stellar atmosphere describes the outer region of a star and typically includes the portion above the opaque photosphere. Stars with sufficiently low temperatures may have outer atmospheres with compound molecules.

Atmospheric pressure at a particular location is the force per unit area perpendicular to a surface determined by the weight of the vertical column of atmosphere above that location. On Earth, units of air pressure are based on the internationally recognized standard atmosphere(atm), which is defined as 101.325 kPa (760 Torr or 14.696 psi). It is measured with a barometer.

Atmospheric pressure decreases with increasing altitude due to the diminishing mass of gas above. The height at which the pressure from an atmosphere declines by a factor of *e* (an irrational number with a value of 2.71828...) is called the scale height and is denoted by *H*. For an atmosphere with a uniform temperature, the scale height is proportional to the temperature and

inversely proportional to the product of the mean molecular mass of dry air and the local acceleration of gravity at that location. For such a model atmosphere, the pressure declines exponentially with increasing altitude. However, atmospheres are not uniform in temperature, so estimation of the atmospheric pressure at any particular altitude is more complex.

Surface gravity differs significantly among the planets. For example, the large gravitational force of the giant planet Jupiter retains light gases such as hydrogen and helium that escape from objects with lower gravity. Secondly, the distance from the Sun determines the energy available to heat atmospheric gas to the point where some fraction of its molecules' thermal motion exceed the planet's escape velocity, allowing those to escape a planet's gravitational grasp. Thus, distant and cold Titan, Triton, and Pluto are able to retain their atmospheres despite their relatively low gravities.

Since a collection of gas molecules may be moving at a wide range of velocities, there will always be some fast enough to produce a slow leakage of gas into space. Lighter molecules move faster than heavier ones with the same thermal kinetic energy, and so gases of low molecular weight are lost more rapidly than those of high molecular weight. It is thought that Venus and Mars may have lost much of their water when, after being photo dissociated into hydrogen and oxygen by solar ultraviolet, the hydrogen escaped. Earth's magnetic field helps to prevent this, as, normally, the solar wind would greatly enhance the escape of hydrogen. However, over the past 3 billion years Earth may have lost gases through the magnetic polar regions due to auroral activity, including a net 2% of its atmospheric oxygen. The net effect, taking the most important escape processes into account, is that an intrinsic magnetic field does not protect a planet from atmospheric escape and that for some magnetizations the presence of a magnetic field works to increase the escape rate.

Other mechanisms that can cause atmosphere depletion are solar wind-induced sputtering, impact erosion, weathering, and sequestration—sometimes referred to as "freezing out"—into the regolith and polar caps.

Atmospheres have dramatic effects on the surfaces of rocky bodies. Objects that have no atmosphere, or that have only an exosphere, have terrain that is covered in craters. Without an atmosphere, the planet has no protection from meteoroids, and all of them collide with the surface as meteorites and create craters.

Most meteoroids burn up as meteors before hitting a planet's surface. When meteoroids do impact, the effects are often erased by the action of wind. As a result, craters are rare on objects with atmospheres.

Wind erosion is a significant factor in shaping the terrain of rocky planets with atmospheres, and over time can erase the effects of both craters and volcanoes. In addition, since liquids can not exist without pressure, an atmosphere allows liquid to be present at the surface, resulting in lakes, rivers and oceans. Earth and Titan are known to have liquids at their

surface and terrain on the planet suggests that Mars had liquid on its surface in the past.

Composition. A planet's initial atmospheric composition is related to the chemistry and temperature of the local solar nebula during planetary formation and the subsequent escape of interior gases. The original atmospheres started with a rotating disc of gases that collapsed to form a series of spaced rings that condensed to form the planets. The planet's atmospheres were then modified over time by various complex factors, resulting in quite different outcomes.

The atmospheres of the planets Venus and Mars are primarily composed of carbon dioxide, with small quantities of nitrogen, argon, oxygen and traces of other gases.

The composition of Earth's atmosphere is largely governed by the by-products of the life that it sustains. Dry air from Earth's atmosphere contains 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and traces of hydrogen, helium, and other "noble" gases (by volume), but generally a variable amount of water vapor is also present, on average about 1% at sea level.

The low temperatures and higher gravity of the Solar System's giant planets—Jupiter, Saturn, Uranus and Neptune—allow them more readily to retain gases with low molecular masses. These planets have hydrogen–helium atmospheres, with trace amounts of more complex compounds.

Two satellites of the outer planets possess significant atmospheres. Titan, a moon of Saturn, and Triton, a moon of Neptune, have atmospheres mainly of nitrogen. When in the part of its orbit closest to the Sun, Pluto has an atmosphere of nitrogen and methane similar to Triton's, but these gases are frozen when it is farther from the Sun.

Other bodies within the Solar System have extremely thin atmospheres not in equilibrium. These include the Moon (sodium gas), Mercury (sodium gas), Europa (oxygen), Io (sulfur), and Enceladus (water vapor).

The first exoplanet whose atmospheric composition was determined is HD 209458b, a gas giant with a close orbit around a star in the constellation Pegasus. Its atmosphere is heated to temperatures over 1,000 K, and is steadily escaping into space. Hydrogen, oxygen, carbon and sulfur have been detected in the planet's inflated atmosphere.

Earliest atmosphere

The first atmosphere consisted of gases in the solar nebula, primarily hydrogen. There were probably simple hydrides such as those now found in the gas giants (Jupiter and Saturn), notably water vapor, methane and ammonia.

Second atmosphere

Out gassing from volcanism, supplemented by gases produced during the late heavy bombardment of Earth by huge asteroids, produced the next atmosphere, consisting largely of nitrogen plus carbon dioxide and inert gases. A major part of carbon-dioxide emissions dissolved in water and reacted with metals such as calcium and magnesium during weathering of crustal rocks to form

carbonates that were deposited as sediments. Water-related sediments have been found that date from as early as 3.8 billion years ago.

About 3.4 billion years ago, nitrogen formed the major part of the then stable "second atmosphere". The influence of life has to be taken into account rather soon in the history of the atmosphere, because hints of early life-forms appear as early as 3.5 billion years ago. How Earth at that time maintained a climate warm enough for liquid water and life, if the early Sun put out 30% lower solar radiance than today, is a puzzle known as the "faint young Sun paradox".

The geological record however shows a continuous relatively warm surface during the complete early temperature record of Earth – with the exception of one cold glacial phase about 2.4 billion years ago. In the late Archean Eon an oxygen-containing atmosphere began to develop, apparently produced by photosynthesizing cyanobacteria (see Great Oxygenation Event), which have been found as stromatolite fossils from 2.7 billion years ago. The early basic carbon isotopy (isotope ratio proportions) strongly suggests conditions similar to the current, and that the fundamental features of the carbon cycle became established as early as 4 billion years ago.

Ancient sediments in the Gabon dating from between about 2,150 and 2,080 million years ago provide a record of Earth's dynamic oxygenation evolution. These fluctuations in oxygenation were likely driven by the Lomagundi carbon isotope excursion.

Third atmosphere

The constant re-arrangement of continents by plate tectonics influences the long-term evolution of the atmosphere by transferring carbon dioxide to and from large continental carbonate stores. Free oxygen did not exist in the atmosphere until about 2.4 billion years ago during the Great Oxygenation Event and its appearance is indicated by the end of the banded iron formations.

Before this time, any oxygen produced by photosynthesis was consumed by oxidation of reduced materials, notably iron. Molecules of free oxygen did not start to accumulate in the atmosphere until the rate of production of oxygen began to exceed the availability of reducing materials that removed oxygen. This point signifies a shift from a reducing atmosphere to an oxidizing atmosphere. O_2 showed major variations until reaching a steady state of more than 15% by the end of the Precambrian.The following time span from 541 million years ago to the present day is the Phanerozoic Eon, during the earliest period of which, the Cambrian, oxygen-requiring metazoan life forms began to appear.

The amount of oxygen in the atmosphere has fluctuated over the last 600 million years, reaching a peak of about 30% around 280 million years ago, significantly higher than today's 21%. Two main processes govern changes in the atmosphere: Plants use carbon dioxide from the atmosphere, releasing oxygen. Breakdown of pyrite and volcanic eruptions release sulfur into the atmosphere, which oxidizes and hence reduces the amount of oxygen in the atmosphere. However, volcanic eruptions also release carbon dioxide, which plants can convert to oxygen. The exact cause of the variation of the amount of oxygen in the

atmosphere is not known. Periods with much oxygen in the atmosphere are associated with rapid development of animals. Today's atmosphere contains 21% oxygen, which is great enough for this rapid development of animals.

Answer the questions:

1. What are the components of atmosphere?
2. What does the atmospheric pressure depend on?
3. What is the role of gas molecules in the atmosphere?
4. Why do atmospheres have dramatic effects on the surfaces of rocky bodies?
5. What can you say about wind corrosion?
6. What is the composition of Earth's atmosphere governed by?
7. What is the atmospheric difference between the planets of Solar System?
8. The earliest atmosphere consisted primarily of hydrogen, didn't it?
9. Describe the second atmosphere. What is its peculiarities?
10. Describe the third atmosphere. What did it consist of?

Text B

Stratification

In general, air pressure and density decrease with altitude in the atmosphere. However, temperature has a more complicated profile with altitude, and may remain relatively constant or even increase with altitude in some regions (see the temperature section, below). Because the general pattern of the temperature/altitude profile is constant and measurable by means of instrumented balloon soundings, the temperature behavior provides a useful metric to distinguish atmospheric layers. In this way, Earth's atmosphere can be divided (called atmospheric stratification) into five main layers. Excluding the exosphere, the atmosphere has four primary layers, which are the troposphere, stratosphere, mesosphere, and thermosphere. From highest to lowest, the five main layers are:

- Exosphere: 700 to 10,000 km (440 to 6,200 miles)
- Thermosphere: 80 to 700 km (50 to 440 miles)
- Mesosphere: 50 to 80 km (31 to 50 miles)
- Stratosphere: 12 to 50 km (7 to 31 miles)
- Troposphere: 0 to 12 km (0 to 7 miles)

Exosphere

The exosphere is the outermost layer of Earth's atmosphere (i.e. the upper limit of the atmosphere). It extends from the exobase, which is located at the top of the thermosphere at an altitude of about 700 km above sea level, to about 10,000 km (6,200 mi; 33,000,000 ft) where it merges into the solar wind.

This layer is mainly composed of extremely low densities of hydrogen, helium and several heavier molecules including nitrogen, oxygen and carbon dioxide closer to the exobase. The atoms and molecules are so far apart that they can travel hundreds of kilometers without colliding with one another. Thus, the exosphere no longer behaves like a gas, and the particles constantly escape into

space. These free-moving particles follow ballistic trajectories and may migrate in and out of the magnetosphere or the solar wind.

The exosphere is located too far above Earth for any meteorological phenomena to be possible. However, the aurora borealis and aurora australis sometimes occur in the lower part of the exosphere, where they overlap into the thermosphere. The exosphere contains most of the satellites orbiting Earth.

Thermosphere

The thermosphere is the second-highest layer of Earth's atmosphere. It extends from the mesopause (which separates it from the mesosphere) at an altitude of about 80 km (50 mi; 260,000 ft) up to the thermopause at an altitude range of 500–1000 km (310–620 mi; 1,600,000–3,300,000 ft). The height of the thermopause varies considerably due to changes in solar activity. Because the thermopause lies at the lower boundary of the exosphere, it is also referred to as the exobase. The lower part of the thermosphere, from 80 to 550 kilometres (50 to 342 mi) above Earth's surface, contains the ionosphere.

The temperature of the thermosphere gradually increases with height. Unlike the stratosphere beneath it, wherein a temperature inversion is due to the absorption of radiation by ozone, the inversion in the thermosphere occurs due to the extremely low density of its molecules. The temperature of this layer can rise as high as 1500 °C (2700 °F), though the gas molecules are so far apart that its temperature in the usual sense is not very meaningful. The air is so rarefied that an individual molecule (of oxygen, for example) travels an average of 1 kilometre (0.62 mi; 3300 ft) between collisions with other molecules. Although the thermosphere has a high proportion of molecules with high energy, it would not feel hot to a human in direct contact, because its density is too low to conduct a significant amount of energy to or from the skin.

This layer is completely cloudless and free of water vapor. However, non-hydrometeorological phenomena such as the aurora borealisand aurora australis are occasionally seen in the thermosphere. The International Space Station orbits in this layer, between 350 and 420 km (220 and 260 mi).

Mesosphere

The mesosphere is the third highest layer of Earth's atmosphere, occupying the region above the stratosphere and below the thermosphere. It extends from the stratopause at an altitude of about 50 km (31 mi; 160,000 ft) to the mesopause at 80–85 km (50–53 mi; 260,000–280,000 ft) above sea level.

Temperatures drop with increasing altitude to the mesopause that marks the top of this middle layer of the atmosphere. It is the coldest place on Earth and has an average temperature around −85 °C (−120 °F; 190 K).

Just below the mesopause, the air is so cold that even the very scarce water vapor at this altitude can be sublimated into polar-mesospheric noctilucent clouds. These are the highest clouds in the atmosphere and may be visible to the naked eye if sunlight reflects off them about an hour or two after sunset or a similar length of time before sunrise. They are most readily visible when the Sun is around 4 to 16 degrees below the horizon. Lightning-induced discharges known as transient

luminous events (TLEs)occasionally form in the mesosphere above tropospheric thunderclouds. The mesosphere is also the layer where most meteors burn up upon atmospheric entrance. It is too high above Earth to be accessible to jet-powered aircraft and balloons, and too low to permit orbital spacecraft. The mesosphere is mainly accessed by sounding rockets and rocket-powered aircraft.

Stratosphere

The stratosphere is the second-lowest layer of Earth's atmosphere. It lies above the troposphere and is separated from it by the tropopause. This layer extends from the top of the troposphere at roughly 12 km (7.5 mi; 39,000 ft) above Earth's surface to the stratopause at an altitude of about 50 to 55 km (31 to 34 mi; 164,000 to 180,000 ft).

The atmospheric pressure at the top of the stratosphere is roughly 1/1000 the pressure at sea level. It contains the ozone layer, which is the part of Earth's atmosphere that contains relatively high concentrations of that gas. The stratosphere defines a layer in which temperatures rise with increasing altitude. This rise in temperature is caused by the absorption of ultraviolet radiation (UV) radiation from the Sun by the ozone layer, which restricts turbulence and mixing. Although the temperature may be −60 °C (−76 °F; 210 K) at the tropopause, the top of the stratosphere is much warmer, and may be near 0 °C.

The stratospheric temperature profile creates very stable atmospheric conditions, so the stratosphere lacks the weather-producing air turbulence that is so prevalent in the troposphere. Consequently, the stratosphere is almost completely free of clouds and other forms of weather. However, polar stratospheric or nacreous clouds are occasionally seen in the lower part of this layer of the atmosphere where the air is coldest. The stratosphere is the highest layer that can be accessed by jet-powered aircraft.

Troposphere

The troposphere is the lowest layer of Earth's atmosphere. It extends from Earth's surface to an average height of about 12 km (7.5 mi; 39,000 ft), although this altitude varies from about 9 km (5.6 mi; 30,000 ft) at the geographic poles to 17 km (11 mi; 56,000 ft) at the Equator, with some variation due to weather. The troposphere is bounded above by the tropopause, a boundary marked in most places by a temperature inversion (i.e. a layer of relatively warm air above a colder one), and in others by a zone which is isothermalwith height.

Although variations do occur, the temperature usually declines with increasing altitude in the troposphere because the troposphere is mostly heated through energy transfer from the surface. Thus, the lowest part of the troposphere (i.e. Earth's surface) is typically the warmest section of the troposphere. This promotes vertical mixing (hence, the origin of its name in the Greek word τρόπος, *tropos*, meaning "turn"). The troposphere contains roughly 80% of the mass of Earth's atmosphere. The troposphere is denser than all its overlying atmospheric layers because a larger atmospheric weight sits on top of the troposphere and causes it to be most severely compressed. Fifty percent of the total

mass of the atmosphere is located in the lower 5.6 km (3.5 mi; 18,000 ft) of the troposphere.

Nearly all atmospheric water vapor or moisture is found in the troposphere, so it is the layer where most of Earth's weather takes place. It has basically all the weather-associated cloud genus types generated by active wind circulation, although very tall cumulonimbus thunder clouds can penetrate the tropopause from below and rise into the lower part of the stratosphere. Most conventional aviation activity takes place in the troposphere, and it is the only layer that can be accessed by propeller-driven aircraft.

Scattering

When light passes through Earth's atmosphere, photons interact with it through *scattering*. If the light does not interact with the atmosphere, it is called *direct radiation* and is what you see if you were to look directly at the Sun. *Indirect radiation* is light that has been scattered in the atmosphere. For example, on an overcast day when you cannot see your shadow there is no direct radiation reaching you, it has all been scattered. As another example, due to a phenomenon called Rayleigh scattering, shorter (blue) wavelengths scatter more easily than longer (red) wavelengths. This is why the sky looks blue; you are seeing scattered blue light. This is also why sunsets are red. Because the Sun is close to the horizon, the Sun's rays pass through more atmosphere than normal to reach your eye. Much of the blue light has been scattered out, leaving the red light in a sunset.

Absorption

Different molecules absorb different wavelengths of radiation. For example, O_2 and O_3 absorb almost all wavelengths shorter than 300 nanometers. Water (H_2O) absorbs many wavelengths above 700 nm. When a molecule absorbs a photon, it increases the energy of the molecule. This heats the atmosphere, but the atmosphere also cools by emitting radiation, as discussed below.

The combined absorption spectra of the gases in the atmosphere leave "windows" of low opacity, allowing the transmission of only certain bands of light. The optical window runs from around 300 nm (ultraviolet-C) up into the range humans can see, the visible spectrum(commonly called light), at roughly 400–700 nm and continues to the infrared to around 1100 nm. There are also infrared and radio windows that transmit some infrared and radio waves at longer wavelengths. For example, the radio window runs from about one centimeter to about eleven-meter waves.

Emission

Emission is the opposite of absorption, it is when an object emits radiation. Objects tend to emit amounts and wavelengths of radiation depending on their "black body" emission curves, therefore hotter objects tend to emit more radiation, with shorter wavelengths. Colder objects emit less radiation, with longer wavelengths. For example, the Sun is approximately 6,000 K (5,730 °C; 10,340 °F), its radiation peaks near 500 nm, and is visible to the human eye. Earth

is approximately 290 K (17 °C; 62 °F), so its radiation peaks near 10,000 nm, and is much too long to be visible to humans.

Because of its temperature, the atmosphere emits infrared radiation. For example, on clear nights Earth's surface cools down faster than on cloudy nights. This is because clouds (H_2O) are strong absorbers and emitters of infrared radiation. This is also why it becomes colder at night at higher elevations.

The greenhouse effect is directly related to this absorption and emission effect. Some gases in the atmosphere absorb and emit infrared radiation, but do not interact with sunlight in the visible spectrum. Common examples of these are CO_2 and H_2O.

Answer the questions:

1. What are the main layers of atmosphere?
2. What can you say about thermosphere?
3. What is mesosphere?
4. What are the peculiarities of stratosphere?
5. What is the lowest layer of atmosphere and its role in weather formation?
6. What is scattering?
7. What is the difference between absorption and emission?

Text C

Air pollution occurs when harmful or excessive quantities of substances including gases, particles, and biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies and even death to humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Both human activity and natural processes can generate air pollution.

Indoor air pollution and poor urban air quality are listed as two of the world's worst toxic pollution problems in the 2008 Blacksmith Institute World's Worst Polluted Places report. According to the 2014 World Health Organization report, air pollution in 2012 caused the deaths of around 7 million people worldwide, an estimate roughly echoed by one from the International Energy Agency.

Exposure

Air pollution risk is a function of the hazard of the pollutant and the exposure to that pollutant. Air pollution exposure can be expressed for an individual, for certain groups (e.g. neighborhoods or children living in a country), or for entire populations. For example, one may want to calculate the exposure to a hazardous air pollutant for a geographic area, which includes the various microenvironments and age groups. This can be calculated as an inhalation exposure. This would account for daily exposure in various settings (e.g. different indoor micro-environments and outdoor locations). The exposure needs to include

different age and other demographic groups, especially infants, children, pregnant women and other sensitive subpopulations. The exposure to an air pollutant must integrate the concentrations of the air pollutant with respect to the time spent in each setting and the respective inhalation rates for each subgroup for each specific time that the subgroup is in the setting and engaged in particular activities (playing, cooking, reading, working, spending time in traffic, etc.). For example, a small child's inhalation rate will be less than that of an adult. A child engaged in vigorous exercise will have a higher respiration rate than the same child in a sedentary activity. The daily exposure, then, needs to reflect the time spent in each micro-environmental setting and the type of activities in these settings. The air pollutant concentration in each microactivity/microenvironmental setting is summed to indicate the exposure. For some pollutants such as black carbon, traffic related exposures may dominate total exposure despite short exposure times since high concentrations coincide with proximity to major roads or participation to (motorized) traffic.

Indoor air quality (IAQ)

A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywood emit formaldehyde(H_2CO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Leadpaint can degenerate into dust and be inhaled. Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items. Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates into the air, inside and out. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation.

Carbon monoxide poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors or in a confined space, such as a tent. Chronic carbon monoxide poisoning can result even from poorly-adjusted pilot lights. Traps are built into all domestic plumbing to keep sewer gas and hydrogen sulfide, out of interiors. Clothing emits tetrachloroethylene, or other dry cleaning fluids, for days after dry cleaning.

Though its use has now been banned in many countries, the extensive use of asbestos in industrial and domestic environments in the past has left a potentially very dangerous material in many localities. Asbestosis is a chronic inflammatory medical condition affecting the tissue of the lungs. It occurs after long-term, heavy exposure to asbestos from asbestos-containing materials in structures. Sufferers have severe dyspnea (shortness of breath) and are at an increased risk regarding several different types of lung cancer. As clear explanations are not always stressed in non-technical literature, care should be taken to distinguish between several forms of relevant diseases. According to the World Health Organization (WHO), these may defined as; asbestosis, *lung cancer*, and *Peritoneal Mesothelioma* (generally a very rare form of cancer, when

more widespread it is almost always associated with prolonged exposure to asbestos).

Biological sources of air pollution are also found indoors, as gases and airborne particulates. Pets produce dander, people produce dust from minute skin flakes and decomposed hair, dust mites in bedding, carpeting and furniture produce enzymes and micrometre-sized fecal droppings, inhabitants emit methane, mold forms on walls and generates mycotoxins and spores, air conditioning systems can incubate Legionnaires' disease and mold, and houseplants, soil and surrounding gardens can produce pollen, dust, and mold. Indoors, the lack of air circulation allows these airborne pollutants to accumulate more than they would otherwise occur in nature.

Health effects

In 2012, air pollution caused premature deaths on average of 1 year in Europe, and was a significant risk factor for a number of pollution-related diseases, including respiratory infections, heart disease, COPD, stroke and lung cancer. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing, asthma and worsening of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency department visits, more hospital admissions and premature death. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, and the individual's health status and genetics. The most common sources of air pollution include particulates, ozone, nitrogen dioxide, and sulphur dioxide. Children aged less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution.

Mortality

The World Health Organization estimated in 2014 that every year air pollution causes the premature death of some 7 million people worldwide. India has the highest death rate due to air pollution. India also has more deaths from asthma than any other nation according to the World Health Organization. In December 2013 air pollution was estimated to kill 500,000 people in China each year. There is a positive correlation between pneumonia-related deaths and air pollution from motor vehicle emissions.[37]

Annual premature European deaths caused by air pollution are estimated at 430,000. An important cause of these deaths is nitrogen dioxide and other nitrogen oxides (NOx) emitted by road vehicles. In a 2015 consultation document the UK government disclosed that nitrogen dioxide is responsible for 23,500 premature UK deaths per annum. Across the European Union, air pollution is estimated to reduce life expectancy by almost nine months. Causes of deaths include strokes, heart disease, COPD, lung cancer, and lung infections.

Urban outdoor air pollution is estimated to cause 1.3 million deaths worldwide per year. Children are particularly at risk due to the immaturity of their respiratory organ systems.

The US EPA estimated in 2004 that a proposed set of changes in diesel engine technology (*Tier 2*) could result in 12,000 fewer *premature mortalities*, 15,000 fewer heart attacks, 6,000 fewer emergency department visits by children with asthma, and 8,900 fewer respiratory-related hospital admissions each year in the United States.

The US EPA has estimated that limiting ground-level ozone concentration to 65 parts per billion, would avert 1,700 to 5,100 premature deaths nationwide in 2020 compared with the 75-ppb standard. The agency projected the more protective standard would also prevent an additional 26,000 cases of aggravated asthma, and more than a million cases of missed work or school. Following this assessment, the EPA acted to protect public health by lowering the National Ambient Air Quality Standards (NAAQS) for ground-level ozone to 70 parts per billion (ppb).

A new economic study of the health impacts and associated costs of air pollution in the Los Angeles Basin and San Joaquin Valley of Southern California shows that more than 3,800 people die prematurely (approximately 14 years earlier than normal) each year because air pollution levels violate federal standards. The number of annual premature deaths is considerably higher than the fatalities related to auto collisions in the same area, which average fewer than 2,000 per year.

Diesel exhaust (DE) is a major contributor to combustion-derived particulate matter air pollution. In several human experimental studies, using a well-validated exposure chamber setup, DE has been linked to acute vascular dysfunction and increased thrombus formation.

The mechanisms linking air pollution to increased cardiovascular mortality are uncertain, but probably include pulmonary and systemic inflammation.

"Clean" areas

Even in the areas with relatively low levels of air pollution, public health effects can be significant and costly, since a large number of people breathe in such pollutants. A study published in 2017 found that even in areas of the U.S. where ozone and PM2.5 meet federal standards, Medicare recipients who are exposed to more air pollution have higher mortality rates. A 2005 scientific study for the British Columbia Lung Association showed that a small improvement in air quality (1% reduction of ambient PM2.5 and ozone concentrations) would produce $29 million in annual savings in the Metro Vancouver region in 2010. This finding is based on health valuation of lethal (death) and sub-lethal (illness) affects.

Alternatives to pollution

There are now practical alternatives to the principal causes of air pollution:

- ✓ Areas downwind (over 20 miles) of major airports more than double *total particulate emissions in air*, even when factoring in areas with frequent ship calls, and heavy freeway and city traffic like Los Angeles. Aviation biofuel mixed in with jet fuel at a 50/50 ratio can reduce jet derived cruise altitude

particulate emissions by 50-70%, according to a NASA led 2017 study (however, this should imply ground level benefits to urban air pollution as well).

- ✓ Ship propulsion and idling can be switched to much cleaner fuels like natural gas. (Ideally a renewable source but not practical yet)
- ✓ Combustion of fossil fuels for space heating can be replaced by using ground source heat pumps and seasonal thermal energy storage.
- ✓ Electric power generation from burning fossil fuels can be replaced by power generation from nuclear and renewables. For poor nations, heating and home stoves that contribute much to regional air pollution can be replaced by a much cleaner fossil fuel like natural gas, or ideally, renewables.
- ✓ Motor vehicles driven by fossil fuels, a key factor in urban air pollution, can be replaced by electric vehicles. Though lithium supply and cost is a limitation, there are alternatives. Herding more people into clean public transit such as electric trains can also help. Nevertheless, even in emission-free electric vehicles, rubber tires produce significant amounts of air pollution themselves, ranking as 13th worst pollutant in Los Angeles.
- ✓ Reducing travel in vehicles can curb pollution. After Stockholm reduced vehicle traffic in the central city with a congestion tax, nitrogen dioxide and PM10 pollution declined, as did acute pediatric asthma attacks.
- ✓ Biodigesters can be utilized in poor nations where slash and burn is prevalent, turning a useless commodity into a source of income. The plants can be gathered and sold to a central authority that will break it down in a large modern biodigester, producing much needed energy to use.
- ✓ Induced humidity and ventilation both can greatly dampen air pollution in enclosed spaces, which was found to be relatively high inside subway lines due to braking and friction and relatively less ironically inside transit buses than lower sitting passenger automobiles or subways.

Reduction efforts

Various air pollution control technologies and strategies are available to reduce air pollution. At its most basic level, land-use planning is likely to involve zoning and transport infrastructure planning. In most developed countries, land-use planning is an important part of social policy, ensuring that land is used efficiently for the benefit of the wider economy and population, as well as to protect the environment.

Because a large share of air pollution is caused by combustion of fossil fuels such as coal and oil, the reduction of these fuels can reduce air pollution drastically. Most effective is the switch to clean power sources such as wind power, solar power, hydro powerwhich don't cause air pollution. Efforts to reduce pollution from mobile sources includes primary regulation (many developing countries have permissive regulations), expanding regulation to new sources (such as cruise and transport ships, farm equipment, and small gas-powered equipment such as string trimmers, chainsaws, and snowmobiles), increased fuel efficiency (such as through the use of hybrid vehicles), conversion to cleaner fuels or conversion to electric vehicles.

Titanium dioxide has been researched for its ability to reduce air pollution. Ultraviolet light will release free electrons from material, thereby creating free radicals, which break up VOCs and NOx gases. One form is superhydrophilic.

In 2014, Prof. Tony Ryan and Prof. Simon Armitage of University of Sheffield prepared a 10 meter by 20 meter-sized poster coated with microscopic, pollution-eating nanoparticles of titanium dioxide. Placed on a building, this giant poster can absorb the toxic emission from around 20 cars each day.

A very effective means to reduce air pollution is the transition to renewable energy. According to a study published in Energy and Environmental Science in 2015 the switch to 100% renewable energy in the United States would eliminate about 62,000 premature mortalities per year and about 42,000 in 2050, if no biomass were used. This would save about $600 billion in health costs a year due to reduced air pollution in 2050, or about 3.6% of the 2014 U.S. gross domestic product.

Regulations

In general, there are two types of air quality standards. The first class of standards (such as the U.S. National Ambient Air Quality Standards and E.U. Air Quality Directive) set maximum atmospheric concentrations for specific pollutants. Environmental agencies enact regulations which are intended to result in attainment of these target levels. The second class (such as the North American Air Quality Index) take the form of a scale with various thresholds, which is used to communicate to the public the relative risk of outdoor activity. The scale may or may not distinguish between different pollutants.

Answer the questions:

1. When does air pollution occur?
2. How can air pollution exposure be expressed?
3. What does the exposure need to include?
4. What does a lack of ventilation bring to?
5. What is one of the most dangerous material in building?
6. What are the effects of air pollution?
7. What is the mortality of people per year in result of air pollution?
8. What are the alternatives to pollution?
9. What reduction effects do you know?

Text D

Air quality law

Air quality laws govern the emission of air pollutants into the atmosphere. A specialized subset of air quality laws regulate the quality of air inside buildings. Air quality laws are often designed specifically to protect human health by limiting or eliminating airborne pollutant concentrations. Other initiatives are designed to address broader ecological problems, such as limitations on chemicals that affect

the ozone layer, and emissions trading programs to address acid rain or climate change. Regulatory efforts include identifying and categorizing air pollutants, setting limits on acceptable emissions levels, and dictating necessary or appropriate mitigation technologies.

Air pollutant classification

Air quality regulation must identify the substances and energies which qualify as "pollution" for purposes of further control. While specific labels vary from jurisdiction to jurisdiction, there is broad consensus among many governments regarding what constitutes air pollution. For example, the United States Clean Air Act identifies ozone, particulate matter, carbon monoxide, nitrogen oxides (NO_x), sulfur dioxide (SO_2), and lead(Pb) as "criteria" pollutants requiring nationwide regulation. EPA has also identified over 180 compounds it has classified as "hazardous" pollutants requiring strict control. Other compounds have been identified as air pollutants due to their adverse impact on the environment (e.g., CFCs as agents of ozone depletion), and on human health (e.g., asbestos in indoor air). A broader conception of air pollution may also incorporate noise, light, and radiation. The United States has recently seen controversy over whether carbon dioxide (CO_2) and other greenhouse gases should be classified as air pollutants.

Air quality standards

Air quality standards are legal standards or requirements governing concentrations of air pollutants in breathed air, both outdoors and indoors. Such standards generally are expressed as levels of specific air pollutants that are deemed acceptable in ambient air, and are most often designed to reduce or eliminate the human health effects of air pollution, although secondary effects such as crop and building damage may also be considered. Determining appropriate air quality standards generally requires up-to-date scientific data on the health effects of the pollutant under review, with specific information on exposure times and sensitive populations. It also generally requires periodic or continuous monitoring of air quality.

As an example, the United States Environmental Protection Agency has developed the National Ambient Air Quality Standards(NAAQS) NAAQS set attainment thresholds for sulfur dioxide, particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide, ozone, nitrogen oxides NO_x, and lead (Pb) in outdoor air throughout the United States. Another set of standards, for indoor air in employment settings, is administered by the U.S. Occupational Safety and Health Administration.

A distinction may be made between mandatory and aspirational air quality standards. For example, U.S. state governments must work toward achieving NAAQS, but are not forced to meet them. On the other hand, employers may be required immediately to rectify any violation of OSHA workplace air quality standards.

Emission standards

Emission standards are the legal requirements governing air pollutants released into the atmosphere. Emission standards set quantitative limits on the permissible amount of specific air pollutants that may be released from specific sources over specific timeframes. They are generally designed to achieve air quality standards and to protect human life.

Numerous methods exist for determining appropriate emissions standards, and different regulatory approaches may be taken depending on the source, industry, and air pollutant under review. Specific limits may be set by reference to and within the confines of more general air quality standards. Specific sources may be regulated by means of performance standards, meaning numerical limits on the emission of a specific pollutant from that source category. Regulators may also mandate the adoption and use of specific control technologies, often with reference to feasibility, availability, and cost. Still other standards may be set using performance as a benchmark - for example, requiring all of a specific type of facility to meet the emissions limits achieved by the best performing facility of the group. All of these methods may be modified by incorporating emissions averaging, market mechanisms such as emissions trading, and other alternatives.

For example, all of these approaches are used in the United States. The United States Environmental Protection Agency(responsible for air quality regulation at a national level under the U.S. Clean Air Act, utilizes performance standards under the New Source Performance Standard (NSPS) program. Technology requirements are set under RACT (Reasonably Available Control Technology), BACT (Best Available Control Technology), and LAER (Lowest Achievable Emission Rate) standards. Flexibility alternatives are implemented in U.S. programs to eliminate acid rain, protect the ozone layer, achieve permitting standards, and reduce greenhouse gas emissions.

Control technology requirements

In place of or in combination with air quality standards and emission control standards, governments may choose to reduce air pollution by requiring regulated parties to adopt emissions control technologies (i.e., technology that reduces or eliminates emissions). Such devices include but are not limited to flare stacks, incinerators, catalytic combustion reactors, reduction reactors, electrostatic precipitators, bag houses, wet scrubbers, cyclones, thermal oxidizers, Venturi scrubbers, carbon absorbers, and biofilters.

The selection of emissions control technology may be the subject of complex regulation that may balance multiple conflicting considerations and interests, including economic cost, availability, feasibility, and effectiveness. The various weight given to each factor may ultimately determine the technology selected. The outcome of an analysis seeking a technology that all players in an industry can afford could be different from an analysis seeking to require all players to adopt the most effective technology yet developed, regardless of cost. For example, the United States Clean Air Act contains several control technology requirements, including Best Available Control Technology (BACT) (used in New Source Review), Reasonably Available Control Technology (RACT) (existing

sources), Lowest Achievable Emissions Rate (LAER) (used for major new sources in non-attainment areas), and Maximum Achievable Control Technology (MACT) standards.

Bans

Air quality laws may take the form of bans. While arguably a class of emissions control law (where the emission limit is set to zero), bans differ in that they may regulate activity other than the emission of a pollutant itself, even though the ultimate goal is to eliminate the emission of the pollutant.

A common example is a burn ban. Residential and commercial burning of wood materials may be restricted during times of poor air quality, eliminating the immediate emission of particulate matter and requiring use of non-polluting heating methods. A more significant example is the widespread ban on the manufacture of dichlorodifluoromethane (Freon)), formerly the standard refrigerant in automobile air conditioning systems. This substance, often released into the atmosphere unintentionally as a result of refrigerant system leaks, was determined to have a significant ozone depletion potential, and its widespread use to pose a significant threat to the Earth's ozone layer. Its manufacture was prohibited as part of a suite of restrictions adopted internationally in the Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer. Still another example is the ban on use of asbestos in building construction materials, to eliminate future exposure to carcinogenic asbestos fibers when the building materials are disturbed.

Hotspots. Air pollution hotspots are areas where air pollution emissions expose individuals to increased negative health effects. They are particularly common in highly populated, urban areas, where there may be a combination of stationary sources (e.g. industrial facilities) and mobile sources (e.g. cars and trucks) of pollution. Emissions from these sources can cause respiratory disease, childhood asthma, cancer, and other health problems. Fine particulate matter such as diesel soot, which contributes to more than 3.2 million premature deaths around the world each year, is a significant problem. It is very small and can lodge itself within the lungs and enter the bloodstream. Diesel soot is concentrated in densely populated areas, and one in six people in the U.S. live near a diesel pollution hot spot. While air pollution hotspots affect a variety of populations, some groups are more likely to be located in hotspots. Previous studies have shown disparities in exposure to pollution by race and/or income. Hazardous land uses (toxic storage and disposal facilities, manufacturing facilities, major roadways) tend to be located where property values and income levels are low. Low socioeconomic status can be a proxy for other kinds of social vulnerability, including race, a lack of ability to influence regulation and a lack of ability to move to neighborhoods with less environmental pollution. These communities bear a disproportionate burden of environmental pollution and are more likely to face health risks such as cancer or asthma.

Studies show that patterns in race and income disparities not only indicate a higher exposure to pollution but also higher risk of adverse health

outcomes. Communities characterized by low socioeconomic status and racial minorities can be more vulnerable to cumulative adverse health impacts resulting from elevated exposure to pollutants than more privileged communities. Blacks and Latinos generally face more pollution than whites and Asians, and low-income communities bear a higher burden of risk than affluent ones. Racial discrepancies are particularly distinct in suburban areas of the US South and metropolitan areas of the US West. Residents in public housing, who are generally low-income and cannot move to healthier neighborhoods, are highly affected by nearby refineries and chemical plants.

I. Answer the questions:

1. What is the "air quality law"? What does it regulate?
2. What are air quality standards? What do they control?
3. What methods exist for determination of emission standards?
4. What are control technology requirements?
5. What can you say about the bans on different emissions?
6. What does air pollution hotspot mean?

II. Translate the proverbs and sayings. Give your own situations with them:

1. To bring somebody back (down) to earth
2. Good heavens!
3. The salt of the earth
4. In the seven heaven
5. To aim at the moon
6. To cry for the moon
7. Once in a blue moon
8. A bit of blue sky

GRAMMAR

Ex. 1 Розкрийте дужки, вживаючи дієслова у необхідному часі.

1. I (to be) very happy when I (to see) him yesterday.
2. She (to hope) now that the weather (to be) fine tomorrow.
3. The ship (to be) in the open sea when the storm (to break) out.
4. Last week he (to find) a kitten in the street. He (to see) that it (to be) absolutely helpless.
5. My uncle, who (to live) in the USA now, (to offer) me to pay for my studying.
6. This time next week I (to live) on a beach.
7. Sam never (to think) to go to medical school.
8. When Sally (to get) to the station last week, she (to realize) that she (to be) too late. The train already (to leave).

9. As a rule she (to run) in the park every day.
10. Look! He (to try) to find his watch. He (to lose) it.
11. Mother just (to make) some sandwiches. You (to like) some?
12. Two days ago Sam (to write) her a letter and (to send) at once.
13. You ever (to be) to Cayman Isles?
14. Don't tease the dog! It (to bite) you.
15. Last night we (not to want) to disturb our parents as they (to have) a rest.
16. His grandparents just (to return) from the USA.
17. I (not to know) where my sister (to be) now. Maybe she (to sit) in the garden.
18. Don't you trunk that marriage (not to change) her? She still (to be) the same.
19. She (to give) him your message tomorrow, as soon as she (to see) him.
20. Look at this child! He (to notice) everything immediately.

Ex. 2 Розкрийте дужки, вживаючи дієслова у необхідному часі.

1. Yesterday at the moment we (to start) eating, the telephone (to ring).
2. She was worried that her child (not to like) her new husband.
3. Look! Her hands (to be) dirty. She (to work) in the gar» den.
4. If you (not to warn) him just now, he (to fall) in the water.
5. Yesterday I (not to want) to stay late so I (to make) an excuse and (to leave).
6. My friend always (to criticize) the way I (to dress).
7. When we (to see) them last?
8. She never (to want) to commit herself to six years of study.
9. If you (to come) at six tomorrow, you (to find) him at home.
10. If you (to know) her address, you (to send) her a letter today.
11. I know what kind of person she is. She always (to say) that she never (to tell) a soul but then she (to break) her promise.
12. This letter (to be) from John. We (to stay) with him last summer.
13. I (to meet) them when they (to run) round the park.
14. When they (to go) out, the rain (to stop), but a strong wind (to blow).
15. Look at him! He never (to be) so insulted!
16. It (to be) dark now. The sun (not to rise) yet.
17. There (to be) an accident near our house last night. You (to hear) it?
18. We (not to recognize) the hotel. We (to stay) in it the year before.
19. Last year when the play (to be) first performed on stage, it (to become) a hit.
20. When I (to come) to my friend, his parents (to tell) me that he (to go) ten minutes before.

Ex.3 Розкрийте дужки, вживаючи дієслова у необхідному часі.

1. You already (to see) this film? — Yes, I (to see) it two days ago. I (to think) it (to be) rather interesting.
2. They already (to get) to the railway station and I (to I think) they (to wait) for their train now.

3. What he (to do) now? - He (to play) the new piano which his parent (to buy) him this morning.
4. She already (to walk) in the park for two hours.
5. Last night my telephone (to ring) four times. Each time I (to answer) the phone, the person at the other end (to ring) off.
6. The police just (to discover) a bomb in this office. They already (to evacuate) the building.
7. She (to see) very tired when she (to get) home yesterday. She (to have) a bad day.
8. After he (to work) for ten hours, he came home and (to fall) asleep.
9. You ever (to be) frightened by something? — Yes, I (to he) frightened by a strange noise in the bushes when I (to run) round the park last week.
10. The day before yesterday he told me that he (not to come) home by seven on Sunday.
11. In the programme we (to watch) last night, they (to kill) animals for their fur.
12. She (to begin) doing her lessons at five. It is seven o'clock but she still (to do) her lessons. When she (to finish) doing them at last?
13. I (not to be) sure now that they (to write) the test by four o'clock.
14. When we (to help) our mother about the house last Sunday, our father (to come) and (to invite) us to cafe.
15. Look! The emergency services (to remove) the sand which oil (to cover).
16. What you (to achieve) by the year 2010?
17. They (to have) a lovely time touring the USA last year.
18. You (not to read) my project yet?
19. Her mother (to be sure) yesterday that she (to revise) for her exam for the following day.
20. In three years time, his parents (to be married) for twenty years.

Ex.4. Розкрийте дужки, вживаючи дієслова у необхідному часі.

1. We (not to imagine) yesterday that the meeting (to take! so long.
2. I am afraid my friend (to be) still in hospital.
3. He (not to finish) medical training till, he is twenty-five.
4. Some days ago I (to go) through my wardrobe and (to pick) out all the clothes which (to be) small for me.
5. She picked the magazine from the floor where it (to fall).
6. You already (to see) this play? — We (to see) it last Friday. It (to be) a bit boring at first but it (to pick) up later on.
7. Now scientists (to predict) that by the year 2025 the population (to rise) to eight billion and by the year 2050 it (to reach) ten billion.
8. How you (to feel)? — I (to feel) so tired today. I **(**to work) in the laboratory since early morning.
9. Be quiet! My baby (to wake up) if you (to shout)! The baby (to sleep) now.
10. My friend wants to open a sport shop. He never (to run) a business before. Now he (to want) to ask for a bank loan.

11. She (to be) very happy when he (to thank) her and (to give) her flowers two days ago.
12. Last September I (to spend) my holiday with my friend. From the first day I (to realize) that I (to make) a mistake.
13. If you (not to pay) the bill immediately, the waiter (to call) the police.
14. The number of cars (to rise) by fifty-eight per cent since 1973.
15. I am sure Sally (to marry) Peter if he (to propose) to her.
16. You still (to think) they (to finish) the new motorway by the end of the year?
17. Why he (to open) a shop? — He always (to want) to open a sweet shop.
18. Last week her sister (to borrow) her sweater. While she (to wear) it she (to spill) some juice on it.
19. She (to be) tired yesterday as she (to drive) all that way.
20. He just (to be) in the bank to pay in a check.

Ex. 5 Розкрийте дужки, вживаючи дієслова у необхідному часі.

1. Where you (to be) just now? I (to wait) for you for ten minutes. Let's go to the cinema. We (to be) late.
2. When I (to enter) the house, I (to see) that the old man (to sit) near the fireplace and (to read) the book. He (to sit) there for a long time.
3. What you (to do) now? — I (to translate) an interesting story. — How long you (to translate) it? — I (to work) for seven hours. I (to hope) I (to finish) translating by nine o'clock.
4. The lecture (not yet to begin) and the students (to talk) in the corridor.
5. Last night Beth (to thank) Chris for the lovely flowers which he (to buy) for her.
6. Oh, I (to see) he (to stop) smoking. When he (to decide) not to smoke?
7. We (to be) in the forest a week ago. We (to hear) how a wild animal (to cry) out. It (to get) in a tramp.
8. I (to be) nervous at the dentist this morning as it was the first time I (see) him since august 1998.
9. When I was a child I (not to like) the girl next door. She always (to tease) me and (to fight) with me.
10. Don't worry! You (to see) your children playing in the yard if you (to look) out of the window.
11. When (to be) last time you (to see) Tom? — Five years ago.
12. I just (to finish) the book which you (to give) me for my birthday.
13. Last night he (to see) a light in the neighbours house
14. My father (to look) tired the day before yesterday. He (to work) at his computer for many hours.
15. She (to be) at the birthday party now. It (to be) the most exciting holiday she ever (to have).
16. You ever (to eat) octopus? — Yes, I .... - What it (to be) like? - It (to taste) nice.

17. Last year my friends (to stay) in my house while I (to be) on holiday. They (to stay) there for three weeks.
18. When I (to come) home, my family (to drink) tea in th^ kitchen. I (to take) my coat off and (to ask) for a cup of tea.
19. We were glad to know that our relatives (to arrive) by the New Year.
20. An important letter (to arrive) when he already (to go) away for two weeks.

Ex. 6 Перекладіть англійською, вживаючи дієслова *у* необхідному часі.

1. Ви коли-небудь відпочивали в Криму? — Так. Ми були там минулого літа. Ми провели два незабутніх тижні на тижні на березі моря.
2. Де твій брат? — Він тренується у спортивному залі. Він там уже дві години.
3. Що діти робили, коли ти прийшов додому? — Коли я увійшов до кімнати, я побачив, що вони грають у нову гру. Я купив її для них в Англії.
4. Де твоя сестра? — Вона на кухні. Вона щойно повернулась з інституту і зараз обідає. Після обіду вона збирається піти на виставку сучасного живопису.
5. Я не хочу розмовляти з ним по телефону. Скажіть йому, що я зайнятий. Попросіть його подзвонити завтра.
6. Вони одружились багато років тому і все ще люблять одне одного. Вони одружені з 1977 року.
7. Ви вже бачили виставку картин Ван Гога? — Ні. Але я дуже хочу побачити її. — Ось два квитки на виставку. Якщо ви будете вільні увечері, приходьте в наш музей.
8. Я дуже стомлена. Наступного тижня я складатиму іспит, тому я зараз напружено працюю. Звичайно я працюю зранку до пізнього вечора.
9. Коли я їхав по дорозі, раптом перед машиною з'явилась кішка. Я одразу зупинив автомобіль. Коли я вийшов з машини, щоб пересвідчитись, що нічого не сталося з твариною, я побачив, що вона втекла.
10. Він глянув на хлопця і одразу зрозумів, що десь бачив його раніше.
11. Моя подруга збирає листівки протягом тривалого часу. Зараз їх у неї так багато, що вона не знає, де їх зберігати.
12. Ось де вони! Ми вас скрізь шукали. Де ви були?
13. Вчора наш клас ходив до музею. Я не пішов, тому що я вже там був.
14. Ви думаєте, завтра буде дощ? — Сподіваємось, що ні. Ми плануємо поїхати за місто. Якщо піде дощ, ми не поїдемо.
15. Поки він робив уроки, його батько слухав радіо. Батько сказав, що останні новини були цікавими.
16. Я й гадки не мав, що вони прийдуть так швидко.
17. Коли діти вийшли з дому, вони згадали, що не взяли з собою парасольку.
18. Нарешті ми прибули в Париж. Я дуже щаслива. Я завжди хотіла побувати в столиці Франції.
19. Він запропонував дітям піти до зоопарку. Він там не був з дитинства.

Ex. 7 Розкрийте дужки, вживаючи дієслова у необхідному часі.

1. You (to have) your contract soon: the secretary (to type) it now.
2. How long he (to wait) for Steve yesterday? — He (to wait) for twenty minutes when Steve (to come) at last.
3. You already (to visit) your doctor? — I (to visit) him two hours ago. — What he (to tell) you? He (advise) to keep to a diet.
4. Are you going to read a letter you (to receive)? - No, I (not to want) to read it now. I (to read) it when I (to be) in a better mood.
5. Yesterday I (to return) home late in the evening. I (to have) supper when my old friend, who just (to arrive) to Kyiv, (to ring) me.
6. You already (to feed) her baby? — I (to feed) it an hour ago. My baby (to sleep) now. It (to sleep) for half an hour.
7. They always (to go) to the country in summer? — Yen, as a rule. But they (to spend) their holiday at the seaside next summer if they (to get) enough money.
8. As the day (to be) sunny last Sunday, we (to decide) to go to the country. We (to get) to our place by ten o'clock. We (to enjoy) ourselves the whole day.
9. What your father (to do) at the moment? - He (to have) breakfast. As a rule he (to have) breakfast so late on Sundays.
10. We (to see) them last week, but we (not to see) them since then.
11. She (to be) a typist for our firm since 1997. She (to work) here for three years. But now she (to want) to change her job.
12. This year he (to write) a book which (to describe) all his
13. They (to walk) a long way when she (to begin) to insist on a rest.
14. Last night he (to be) furious because someone (to drive) into his car while it (to be) parked.
15. I (to tell) you a million times (not to take) my sweater! Why you (to wear) it now? If you (to put) it on again we (to quarrel).
16. They (to decide) to go to Spain. Because their friends often (to tell) them about their glorious holiday there.
17. His brilliant intellect (to win) him an international reputation.
18. Nick already (to get) tickets for the concert? — He (to have) the tickets but nobody to go with him.
19. My friend (to ask) me to explain him new rule because he (not to understand) it.
20. He was sure that she (to invite) him to her birthday party which (to take) place in a week.

Ex. 8 Перекладіть англійською мовою, вживаючи дієслова у необхідному часі.

1. Ви все ще вивчаєте англійську мову? — Так. Я вивчаю її вже два роки. Мій вчитель каже і я відчуваю, що я досяг успіху у навчанні.
2. Ми плануємо вилетіти завтра, якщо нічого не трапиться.

3. Я давно не бачив своїх друзів. Я хочу, щоб вони приїхали на мій день народження. Весь вечір ми будемо спілкуватися.
4. Коли він повернеться з обідньої перерви? Ми чекаємо його вже п'ятнадцять хвилин, а він іще не прийшов. Якщо він не з'явиться за десять хвилин, ми підемо.
5. Коли вона з'явилась у офісі, вона помітила, що всі з подивом дивляться на неї. Вона зрозуміла, що запізнилась.
6. Ти не знаєш, куди я поклала свою чорну сумку? Я намагаюсь знайти її вже півгодини. Ти не бачила її? — Вчора я бачила її у тій кімнаті.
7. Він думав, що весь вечір буде займатися виключно своїми справами. Але він помилився: дружина попросила його піти в магазин.
8. Я колись давно читав цю книжку. Зараз я перечитую її з великим задоволенням.
9. Твоя мама вже повернулась з роботи? Я хочу поговорити з нею. — Ні, її ще немає, але вона прийде додому за годину.
10. Ми працюємо вже три години, але ще не стомились. Давайте попрацюємо ще дві години. Якщо ми стомимось раніше, ми зробимо перерву.
11. Коли я зайшов до школи, я побачив, що мій вчитель розмовляє з двома учнями. Я підійшов до нього лише після того, як учні пішли.
12. Він вже переклав текст? — Так, він переклав його до сьомої години.
13. Я хочу знати, чи вони вже отримали необхідну інформацію.
14. Ваша сестра студентка? - Ні, вона вже закінчила інститут. Вона закінчила його рік тому.
15. Якщо піде дощ і погода буде вітряною, моя бабуся погано почуватиме себе.
16. З ким він зустрічав Новий рік? - Ніхто не знає. Він нікому не сказав про це.
17. Я не знав куди переїхала їхня сім'я.
18. Вони сперечаються вже півгодини.
19. Якщо вони не припинять сперечатися самі, я попрошу їх зробити це.
20. Коли я прийшов додому, моя сім'я вже повечеряла всі пили каву на кухні.
21. Коли він подзвонив своєму другові, той приймав ванну уже десять хвилин і тому не підійшов до телефону.

Ex.9 Розкрийте дужки, вживаючи дієслова у необхідні ному часі.

1. Cora (to want) to have a dog. She says "If I (to have) « dog, I (to have) a friend". When she (to come) from school in the afternoon, she (to decide) to ask her mothel to let her to have a dog.
2. He (not to sleep) that night. He (to think) till the morn ing: his head (to be) full of thoughts. When the morning (to come) he (to take) decision at last.
3. After we (to say) good-bye to the old man we (to go) out of the house. It (not to be) anybody in the street. The sun (to shine) brightly in the sky.
4. "I (to clean) my room and (to put) everything in its place", she said. "You see, now I (to go) away".

5. When I (to look) at my friend, I (to see) that he **(**to smile) from ear to ear. He (to read) a funny story.
6. My parents (to look) at me as I (to come) in. “Where you (to be)?” exclaimed my mother. “We (to wait) for you since five o’clock”. She (to be) very angry with me.
7. It (to be) a nice party last night. Everybody (to dance) and (to be) happy. My friend (to bring) great music.
8. If he (not to have) the money tomorrow, they (to give) this puppy to another boy and he never (to see) him, again.
9. Last night John (to be) at his sports club. He (to think) he (to recognize) a girl who (to come) into the gym. “I (to think) I (to see) you somewhere before,” he said.
10. Yesterday my father (to want) to telephone his old friend. They (not to see) each other for ages. My father (to think) that he (to forget) his telephone number.
11. Two hours ago we (to speak) in my room. We (to hope) that nobody (to hear) our conversation.
12. Right now he (to need) to improve his social English for his job.
13. Yesterday, I (to come) to my dentist. I (to wait) for him in the reception. When his secretary (to come), she (to offer) me to read a magazine I (to refuse) as I (to wait) for him for fifteen minutes and (to read) all the magazines.
14. As a teenager she (to be) a shy person but she (to become) very self-confident after she (to return) from a year abroad.
15. Last morning, when Beth (to look) out of the window, she (to realize) that it (to snow) all night. Beth (to decide) she (not to go) for a walk at three o’clock.

Ex. 10 Перекладіть англійською мовою, вживаючи дієслова у необхідному часі.

1. Як тільки я зайшов до кімнати, я зрозумів, що хтось палив у ній. Я відкрив вікно, щоб провітрити кімнату.
2. Під час обіду вона була в поганому настрої. Вона намагалась додзвонитись на залізничну станцію протягом всього ранку, але лінія весь час була зайнята.
3. Ти думаєш, що ти можеш виконати цю роботу сам? Ти помиляєшся. Ти не закінчиш її до вечора, якщо ми тобі не допоможемо.
4. Скільки днів ти працюєш над цією статтею? — Я пишу її вже п’ять днів, але ще не дописав її до кінця. Я планую закінчити її через сім днів. — Ти даси мені почитати її, як тільки напишеш?
5. Коли вона побачила, як глибоко він порізав руку, вона не злякалась. До цього вона вже багато разів бачила кров.
6. Де твій брат? — Він у парку. Він гуляє з собакою. Він вийшов з дому десять хвилин тому. — Коли він повернеться? — Я думаю, вони гулятимуть ще хвилин двадцять.
7. Ми отримали телеграму пізно ввечері. Як тільки ми прочитали цю телеграму, ми сіли в машину і поїхали до бабусі. Ми сподівалися приїхати до бабусі до ночі.

8. Одягни пальто. Що ти робитимеш, якщо стане холодно? Ти можеш застудитися, погода змінюється протягом дня.
9. Тепер я розумію, чому я не можу відкрити двері. Вже п’ять хвилин я намагаюся відкрити їх не тим ключем. Ключ від цих дверей я забув на роботі.
10. Мій брат чудовий письменник. Він написав кілька книжок, які стали відомими у всьому світі. Зараз мій працює над новою книжкою.
11. Ми сподівалися, що вона приїде о сьомій годині. Але ми помилились. Її поїзд прибув о восьмій. Ми годину чекали її на вокзалі.
12. З ким ти розмовляв, коли я зустрів тебе вчора? Жінка, з якою я розмовляв, була моєю вчителькою іспанської кілька років тому. Мені було приємно поговорити з нею, тому що ми не бачились приблизно два роки.
13. Що з тобою? — Думаю, що я захворів. У мене висок» температура. — Якщо ти хворий, я раджу тобі викликати лікаря.
14. Що ви робитимете завтра о сьомій вечора? — Ми прийдемо додому о шостій, а о сьомій годині ми будемо дивитись серіал. Ми повечеряємо до восьмої години, і о восьмій підемо на прогулянку.
15. Я давно не отримував листів від своїх друзів. На цьому тижні я написав кілька листів і сподіваюсь отримати відповіді через тиждень.
16. Завтра у нього урок англійської мови. Він писатиме диктант на уроці. Зараз він вчить слова. Він вивчить їх до сьомої години.
17. її двоюрідна сестра вчиться в інституті. Вона вчиться уже три роки. Через два роки вона закінчить навчання. — Яку професію вона обрала? — Вона буде лікарем.
18. Коли він побачив її, він підстрибнув від здивування: вона дуже дивно вбралась.
19. Що ти робитимеш, коли ми прийдемо? — Я робитиму уроки. Я робитиму їх вже півтори години, коли ви прийдете.

Ex. 10 Перекладіть англійською, вживаючи дієслова у необхідному часі.

1. Вони йшли вулицею і розмовляли, коли вона раптом забула, що хотіла сказати.
2. Хіба ти не пам’ятаєш, як я сказав, що ми запізнимось на збори?
3. Коли я зустрів її хвилин двадцять тому, її очі були червоні. Я зрозумів, що вона плакала.
4. Він уже півгодини намагається знайти свого сина. Я думаю, що хлопчик десь сховався.
5. Коли вона прийшла додому, вона згадала, що забула зайти до зубного лікаря. Вона набирала номер майже півгодини, але лінія була зайнята.
6. Його друзі чекають на нього вже годину, а він все ще не прийшов. Якщо він не прийде за десять хвилин, . вони підуть на дискотеку без нього.
7. Ми погодились, коли вона запропонувала нам піти в театр. Вона запевняла, що вистава буде чудовою.

8. Я прийшов додому о сьомій. Я повечеряв і почав читати книжку, яку я взяв у бібліотеці. Я читав її вже півгодини, коли я згадав, що не подзвонив своєму двоюрідному братові.
9. Ми не думали, що він візьме участь у цій роботі. Він завжди намагається уникнути будь-яких додаткових завдань.
10. Як тільки я звільнюсь, я подзвоню тобі. Я ще ніколи не брав участі у подібних заходах, тому мені треба добре подумати, перш ніж я дам відповідь.
11. З того часу, як ми приїхали сюди на відпочинок, сніг іде щодня.
12. Вони прийшли додому опівночі, тому що вечірка закінчилась пізно. Коли вони зайшли до квартири, вони побачили, що всі вже сплять.
13. Де живе твоя тітка? — Вона поїхала до Харкова п'ять років тому і з того часу живе там.
14. Жінка сиділа біля вікна і думала. Вона думала про те, що її подруга не зайшла до неї перед тим, як поїхати до Києва.
15. Ми не сподівались, що вони приїдуть так швидкої Ми не приготували кімнату до їхнього приїзду.

Ex. 11 Розкрийте дужки, вживаючи дієслова у відповідному часі.

1. They already (to announce) the results of our tests? Yes, they (to do) it some minutes ago. — What mark you (to get)?
2. What (to be) wrong? I see you (to be) in a bad mood? - I (to translate) this article since morning, but I (not to finish) it yet.
3. Where they (to be)? — Last week they (to leave) foe Paris. If I (to receive) any news, I (to let) you know.
4. You (to know) him well? - I (to know) him since childhood. He always (to be) a very honest man.
5. What he (to do) in the garden some minutes ago? — He (to find) a little bird. He (to think) it (to fall) out of the nest.
6. Yesterday on my way home I (to meet) my daughter. She (to tell) that (to wait) for me for two hours. She **(**to lose) her key.
7. He always (to dream) to become an actor. He (to dream) about it since childhood.
8. I (to be) very tired, when I (to come) home yesterday. When I (to begin) to warm my dinner, my friend **(**to phone) me. We (to speak) only for five minutes, but when I (to enter) the kitchen, I (to see) that I **(**to burn) it.
9. After they (to spend) their holidays together, she (to understand) that her friend (not to be) such nice per son as she (to think).
10. You (to take) you children to the zoo next Sunday? Yes, they never (to be) in the zoo before. I (to hope) they (to like) it.
11. One morning a letter (to arrive) to them. The letter said that their aunt (to arrive) the next day.
12. Who (to give) you my phone number? — I (to ask) Nick to give me your number as I (to want) to tell you something very important.

Ex. 12 Перекладіть англійською мовою, вживаючи дієслова у *Present, Past* та *Future Simple Passive.*

1. Мені розказали	Мені розказують	Мені розкажуть
2. Йому показали	Йому показують	Йому покажуть
3. їй дали	Їй дають	Їй дадуть
4. Мені допомогли	Мені допомагають	Мені допоможуть
5. Його помітили	Його помічають	Його помітять
6. Нас запросили	Нас запрошують	Нас запросять
7. їм дозволили	Їм дозволяють	Їм дозволять
8. їй порадили	Їй радять	Їй порадять
9. Його почули	Його чують	Його почують
10. Мені повірили	Мені вірять	Мені повірять
11. Їх впізнали	Їх впізнають	Їх впізнають
12. Його згадали	Його згадують	Його згадають

Ex. 13 Розкрийте дужки, вживаючи дієслова у *Present, Past, Future Simple Passive.*

1. His car (to steal) last night.
2. Cheese (to make) from milk.
3. The dog (to give) some food in ten minutes.
4. The telegram (to receive) last week.
5. These television (to make) in Japan.
6. He (to give) a lot of money last month.
7. All the students (to invite) to the party next week.
8. I (allow) to go for a walk now.
9. This man (to arrest) last year.
10. My question (to answer) soon.
11. Her book (to finish) this month.
12. The article (to translate) in three days.
13. Furniture (to make) from wood and plastic.
14. The news (to announce) tomorrow.
15. The patient (to take) to hospital last Friday.
16. The pupils (to explain) a new rule at the next lesson.
17. He (to appoint) a new manager.
18. Dictations (to write) every day.
19. This newspaper (to sell) everywhere.

Ex. 14 Перекладіть англійською мовою, вживаючи дієслова у *Present, Past, Future Simple Passive* або *Active.*

1. Я попросив свого друга допомогти мені.
2. Мене попросили допомогти йому.

3. Вчитель дав учням важке завдання.
4. Учням дали важке завдання.
5. Ми часто обговорюємо важливі питання вдома.
6. Важливі питання ми обговорюємо вдома.
7. Завтра вона закінчить цю роботу.
8. Цю роботу буде закінчено завтра.
9. Вона сказала нам правду.
10. Нам сказали правду.
11. Іноді він забуває купити хліба.
12. Чому про це часто забувають?
13. Він поверне книжку вчасно.
14. Книжку буде повернено вчасно.
15. Ці будинки побудували два роки тому.
16. Мама не дозволяє їм грати на вулиці.
17. Їм не дозволяють грати на вулиці.
18. Коли будуть відправлені листи?
19. Вони зустрінуть нас на вокзалі.
20. Де нас зустрінуть?

Ex. 15 Перекладіть англійською мовою, вживаючи дієслова у *Present, Past, Future Simple Passive* або *Active.*

1. Книжки поставлять на полиці.
2. Хто виконає цю роботу?
3. Коли цю роботу буде виконано?
4. Я куплю машину.
5. Де купили цю машину?
6. Мене зустріли на вокзалі.
7. Наступного тижня ми напишемо тест.
8. Що було написано в листі?
9. Ми забули замкнути двері.
10. Двері були замкнені.
11. Квіти зріжуть і поставлять у вазу.
12. Де продають ці журнали?
13. Коли перевірять наші диктанти?
14. Він помив підлогу годину тому.
15. Годину тому підлогу помили.
16. Як виконають це завдання?
17. Йому не дадуть цих паперів.
18. Нам не показали нового фільму.
19. Він показав нам свою кімнату.
20. Магнітофон буде відремонтовано вчасно.

Ex. 16 Розкрийте дужки, добираючи необхідну форму дієслова.

I They (posted/were posted) the letters yesterday.
The letters (posted/were posted) yesterday.
You can (leave/be left) your case here.
13. The case can (leave/be left) here. f>. He will (tell/be told) me the truth.
(I. The truth (tell/is told) to me.
You may (put/be put) your hat on.
I. The hat may (put/be put) on.
I The machine mustn't (use/be used) after six o'clock.
17. They mustn't (use/be used) the machine.
18. Tomorrow I will (pay/be paid) the bill.
19. Tomorrow the bill will (pay/be paid).

Запам'ятайте такі словосполучення:
(зверніть увагу на місце прийменника).

to talk about	She is talked about.
to send for	He was sent for.
to look at	She was looked at.
to laugh at	He is often laughed at.
to wait for	I was waited for.
to care for	His child is cared for.
to listen to	They are listened to.

Запам'ятайте, що коли необхідно зазначити особу або об'єкт, з боку якого підмет зазнає впливу, то вживають зворот з прийменником ***by****:*

This book is written **by** Hemingway.

Ex. 17 Передайте речення в *Passive Voice,* зважаючи на місце в реченні відповідного прийменника.

1. He often thinks about her.
2. We looked for her everywhere.
3. People speak much about this film.
4. They sent for Alice.
5. She cares for her baby well.
6. They always laugh at Tom.
7. We will listen to the teacher attentively.
8. I always wait for my friend for a long time.
9. She asked for this book.
10. He will look for his key.
11. They will speak about this accident long.
12. He never listens to mother's advices.

Ex. 18 Передайте речення в *Passive Voice.*

1. He broke his bicycle.
2. She will write a new book.
3. We will forgive his mistake.
4. Mother does not allow me to come home late.
5. She teaches us English.
6. The guide organized excursion well.
7. We will discuss this question in our office.
8. The pupils planted many trees near school.
9. She will serve dinner at two o'clock.
10. My little sister broke a cup.
11. We wash the dishes every day.
12. Our grandmother will send the telegram.
13. My doctor prescribed me this medicine.
14. A man showed me the way to her house.
15. My brother booked the tickets.
16. I will translate this text in the morning.
17. Jane wrote an interesting article.
18. The doctor examined patients every day.

Ex. 19 Перекладіть англійською мовою.

1. Цю статтю треба перекласти.
2. Квіти можна поставити у вазу.
3. Питання можна задати в кінці уроку.
4. їх треба запросити на вечерю.
5. Цим підручником можна користуватися.
6. Таксі можна викликати додому.
7. Обідати треба вчасно.
8. Нашу кімнату треба перевірити.
9. Речі можна покласти у шафу.
10. Треба зустріти бабусю на вокзалі.
11. Собаку потрібно взяти на прогулянку.
12. Нові слова треба вивчити.

Ex. 20 Розкрийте дужки, вживаючи дієслова у *Passive Voice.* Перекладіть українською мовою.

1. My father (to send) to the rest-house yesterday.
2. This work must (to finish) in an hour.
3. I'm sure your voice (to hear) in the next room.
4. The question (not to discuss) at the last conference.

5. She (to introduce) to them next week.
6. The letter (to receive) some hours ago.
7. His picture (to show) in this museum now.
8. When they (to ask) to come here?
9. Why my things (not to pack) yesterday?
10. The child (to take) for a walk by his mother.
11. The car (to buy) next month?
12. I (not to give) their address the day before yesterday.
13. What language (to teach) at his school?
14. My dinner must (to cook) in time.

Ex. 21 Передайте речення в *Active Voice.*

1. I am sure I will be asked by police about this accident.
2. His honesty was acknowledged by all.
3. The leading role will be performed by my favourite actress.
4. The article has been altered by Nick.
5. His decisions are always approved by her.
6. The city was attacked by the enemies.
7. The window has been left open by somebody.
8. His adventures were described in his book.
9. The equipment has just been delivered.
10. My departure has been planed by me before.
11. We were told that our order had not been fulfilled by the manager.
12. The children were not punished by their parents.
13. His poem is being learned by heart by Mary.
14. He was recognized as a brilliant musician by all.
15. The newspaper is being published at the moment.
16. The animal was being found at four o'clock.
17. His behaviour can't be understood by us.
18. She was not taken to the concert by her brother.
19. Our café is visited by a lot of people.

Ex. 22 Перекладіть англійською мовою, вживаючи дієслова у *Passive Voice.*

1. Їм уже вручили призи?
2. Протягом року тут вирощували овочі та фрукти.
3. Килими все ще чистять.
4. Інструкції прочитали та обговорили.
5. Вона сказала, що чек загублено.
6. Нам сказали, що всі варіанти відповіді було запропоновано.
7. В цьому готелі приймають багато знаменитих людей.
8. Нашу пропозицію не можна забути.

9. Злочинця необхідно знайти.
10. Ліжко в твоїй кімнаті ще не застелене.
11. Нас помітили одразу.
12. Чому ще не складено списки?
13. Я припускаю, що товари не доставлять завтра.
14. Ці картини можна побачити в музеї сучасного живопису.
15. Коли я зайшов у кабінет, це питання все ще обговорювали.
16. В цьому журналі друкують дуже цікаві статті.
17. Мого друга призначено директором школи.
18. Цю пісню співають всі.
19. Ми думали, що нас запросять на збори.
20. Я запитав сестру, чи вже написано листа.

Ex. 23 Перекладіть англійською мовою, вживаючи дієслова у *Passive Voice.*

1. Поліцейський сказав, що ніяких відбитків не знайдено.
2. Він був наляканий собакою.
3. Ці слова було сказано пошепки.
4. Анкети все ще заповнюють.
5. Їй не дозволяють виходити з дому пізно.
6. Вчора на неї напав чийсь собака.
7. Їх не візьмуть до команди, якщо вони не тренувати.
8. Багато теплих слів було почуто на вечорі.
9. Коли я зайшов до кімнати, то я побачив, що його розповідь дуже уважно слухають.
10. Вчора її відрекомендували моїм батькам.
11. Яку з його книжок перекладуть українською мовою?
12. Бабусину телеграму отримали перед святом.
13. Коли мама прийде додому, всі кімнати буде прибрано.
14. В енциклопедії можна знайти багато цінної інформації.
15. Цей собор відвідує багато людей.
16. Коли вона мила вікно, то вона побачила, що скло розбито.
17. Йому не дозволять водити автомобіль, поки йому не виповниться сімнадцять років.
18. Цей малюнок можна виконати олівцем.
19. Всі необхідні продукти купили перед святом.
20. В цій лікарні добре доглядають за пацієнтами.

LESSON 2

AGROMETEOROLOGY

Answer the questions:

1. What is the importance of studying agrometeorology in relation to agriculture?
2. How does agrometeorology differ from agroclimatology?
3. What is the importance of agroclimatology in crop production?

Text A

1. Agrometeorology is the study of weather and use of weather and climate information to enhance or expand agricultural crops and/or to increase crop production. Agrometeorology mainly involves the interaction of meteorological and hydrological factors, on one hand and agriculture, which encompasses horticulture, animal husbandry, and forestry.

It is an interdisciplinary, holistic science forming a bridge between physical and biological sciences and beyond. It deals with a complex system involving soil, plant, atmosphere, agricultural management options, and others, which are interacting dynamically on various spatial and temporal scales. Specifically, the fully coupled soil-plant-atmosphere system has to be well-understood in order to develop reasonable operational applications or recommendations for stakeholders. For these reasons, a comprehensive analysis of cause-effect relationships and principles that describe the influence of the state of the atmosphere, plants, and soil on different aspects of agricultural production, as well as the nature and importance of feedback between these elements of the system is necessary.

Agrometeorological methods therefore use information and data from different key sciences such as soil physics and chemistry, hydrology, meteorology, crop and animal physiology and phenology, agronomy, and others. Observed information is often combined in more or less complex models, focused on various components of system parts such as mass balances (i.e. soil carbon, nutrients, and water), biomass production, crop growth and yield, and crop or pest phenology in order to detect sensitivities or potential responses of the soil- biosphere - atmosphere system. However, model applications still involve many uncertainties, which calls for further improvements of the description of system processes.

Agricultural meteorology – its scope and aims.

2. Aims. The primary aim of agricultural meteorology is to extend and fully utilize our knowledge of atmospheric and related processes in order to optimize sustainable agricultural production with maximum use of weather resources and with minimal damage to the environment. This entails improving the quantity and quality of agricultural crops, timber and other forest products (e.g. natural rubber), vegetable fibres (e.g. cotton, flax, sisal), and animal products and byproducts (e.g. hides).

A secondary aim concerns the conservation of natural resources. The climate may place constraints upon a particular resources. The climate may place constraints upon a particular form of land-use at a given place and time. An agricultural meteorologist should be (but often will not be) consulted when questions are being examined of land-use, of the exploitation of resources and of the deployment of technological processes. For example, the short-term benefit from the cultivation of semi-arid grassland has often (e.g. in the former Soviet Union) been gained at the expense of long-term damage from erosion by wind and water. Meteorologists have the advantage of being able to take into consideration processes on very different time-scales.

Range of subject matter.

The subject includes:

(a) The Earth (physical) sciences - specifically the physics of the atmosphere, i.e. meteorology and climatology, but also soil physics and hydrology;

(b) Certain biological sciences - specifically physiology, ecology and pathology of plants and animals, and associated "technologies" of agriculture.

A more detailed statement is given in the opening paragraphs of the WMO Guide to Agricultural Meteorological Practices (WMO-No. 134):

"Agricultural meteorology is concerned with interaction between meteorological and hydrological factors, on the one hand, and agriculture in the widest sense, including horticulture, animal husbandry and forestry, on the other hand. Its object is to discover and define such effects, and thus to apply knowledge of the atmosphere to practical agricultural use. Its field of interest extends from the soil layer of deepest plant and tree roots, through the air layer near the ground in which crops and woods grow and animals live, to the highest levels of interest to aerobiology, the latter with particular reference to the effective transport of seeds, pollen and insects.

In addition to natural climate, and its local variations, agricultural meteorology is also concerned with artificial modifications in environment (as brought about, for example, by windbreaks, soil management, irrigation, glasshouses, etc.); in climatic conditions storage, whether indoors or in field heaps; in environmental conditions, in animal shelters and farm buildings; and during the transport of agricultural produce by land, sea or air."

This compendium considers the relationship between weather and agriculture, and touches upon subjects that may be conveniently classified under seven main headings: soil and water, plants, farm animals, diseases and pests of crops and animals, farm buildings and equipment, farm operations, and artificial modification of the meteorological and hydrological regime. Each of these will be briefly discussed in this chapter.

Soil and water. Weathering is an important factor in creating and then determining the nature of a soil, the organisms it contains and its capacity for retaining and releasing heat, nutrients and moisture. Rainfall not only adds chemical components to the soil, but it also washes out ("leaches") soil nutrients.

The mechanical state of the soil - as it affects the cultivation, pest control and harvesting of crop plants, management of pastures (stocking density, etc.) is greatly influenced by local weather conditions. In these matters the cooperation of environmental scientists is vitally important: meteorologists must not simplify too much the surface aspects of their work, while on the other hand hydrologists should not assume full knowledge of all weather and climate factors. All in all, cooperation between meteorologists, hydrologists and soil scientists needs to be improved.

The water reservoir for plant growth and development is contained in the soil. The amount of water available in soil depends on the effectiveness of precipitation or irrigation, on the one hand, and on soil's physical properties and depth on the other hand. The rate of water loss from the soil depends on the climate, and on the physical properties of the soil and the root system of the plant community. Efficient utilization of soil water and cultivation techniques for preservation of soil moisture are of major concern to agrometeorology, especially in semi-arid areas.

Erosion by wind and water depends on regional and local weather factors. The extent to which a given tract of land suffers from erosive agencies is, moreover, determined by the presence and vigour of the vegetative cover. Excessive concentration of salt at the soil surface may occur in areas especially where there is significant evaporation and drainage is not adequate, particularly when irrigation water is poor quality.

In all regions with a marked seasonal variation in weather, seasonal changes influence soil conditions and hence the farming programme ('calendar') - e.g. the beginning and end of rainy seasons in (sub) tropical countries; in wet climates, the period during which the water content of the upper soil layers exceeds the 'field capacity' ; or the duration of frozen ground in high latitudes.

Review Exercises:

1. What kind of science is agrometeorology?
2. Discuss three main passages of Text A (part 2) and put the questions to each of them.

Text B

USE AND PROVISION OF AGROMETEOROLOGICAL INFORMATION

To illustrate the variety of information requirements in agrometeorology, we will list a few of the categories of users that meteorologists are expected to support, showing how their needs vary. These user groups are not listed in any order of importance and their characteristics, situation and requests may differ from country to country.

Owners of large farms of one km^2 or more are often faced with large investments to be made, in mechanization and sometimes also in (part-time) labour. Generally speaking, they grow a limited number of crops, progressing in some cases to monoculture. In order to run such agricultural factories professionally, they may require extensive weather and climate information for planning, sometimes in a computer-compatible form.

A horticulturist, dealing with high-value crops grown over a very small area, usually controls the climatic conditions as much as possible in a greenhouse or in plastic tunnels. In order to make the necessary adjustments to regulate the radiation passing through his roof and the ventilation air entering below it, he must have quantitative information on e.g. local humidity and cloudiness as a routine matter.

Intermediate in scale between the two above-mentioned market-directed types of farming are family farms. Their main products are usually animals or regional staples - viticulture, cereal, grain or rice, grasses, beans or beets, fruits, sugarcane, vegetables - and some supporting minor crops or animals besides. These farmers are usually avid customers of agro-weather broadcasts (particularly on hazards such as frosts) which guide their short-term operational decisions.

Cattle farmers need weather information to provide winter forage their herds, e.g. to find out when they can make hay. In latitudes without winter, farmers are interested in early warning about impending disasters such as floods or storms.

Government planners (say, from the Ministry of Agriculture) may have the task of forecasting the yield of the next national staple crop harvest, as an 'early warning' of crop failures is necessary information for economic measures. This means that the meteorologist must know about the reliability of existing weather-related crop development models. Another subject for government advice is the climatological suitability of various regions for growing new types of crops.

Agricultural product factories, and other related business involved in processing or transporting food for the market, can use long-term forecasts and climatic information for planning purposes - provided that they are able to use predictions phrased in terms of probability. They prefer statistical climate studies to climate models (Changnon, 1992).

Investigators specialized in related subjects like hydrology and agronomy often ask for meteorological datasets. This should be used to start cooperation.

Agrometeorological service. In order to cope adequately with such varied requests, it is essential to establish an agrometeorological unit - preferably in a National Meteorological Service where, together with forecasting services and a national database, the necessary infrastructure for data collection and analysis is already in existence. In 1980 a WMO working group recommended three subsequent development stages after the establishment of such a unit:

(1) A 'passive' pre-operational stage using available infrastructure, supplying simple climatic information for agriculture more efficiently by assigning this task specifically to a few members of a climatological service. At this stage a national agrometeorological committee, supported by WMO and FAO, should identify local weather-sensitive problems;

(2) A more ‘active’ stage, in which derived information (e.g. growing degree days, leaf-wetness duration) is provided by a specialized unit. Some countries might stop here;

(3) An operational stage, where advisory services and forecasts are provided, and the necessary research is done to support such problem-oriented services.

Agrometeorology and agroclimatology can assist in two categories of problems which could be designated as the tactics and the strategy of food production. Strategic considerations cover the choice of crop, selection of farm animals, design and extent of farm machinery, and methods of soil cultivation. Strategic planning, in particular, includes the correct choice of land use, production facilities and genetic issues. Likewise, a statistical study of past climates, their variability, the range of possibilities - particularly extremes and sequences which the atmosphere can generate - can prove useful in risk assessment of nature proposals.

Tactical items relate to short-term timing of farm operations, and all that goes to make up good husbandry. Weather forecasts can play a tactical role, always provided that such predictions are reliable and accessible, that they do not omit farming-related weather parameters - and that agricultural effects of approaching weather are either understood by weatherwise farmers, or stated clearly in the forecast.

A forecast can only be useful if there is some action that the recipient can undertake, either to take advantage of favourable circumstances, or to reduce adverse effects. All too often farmers are powerless to act - an aircraft can change course to avoid a hailstorm, but farmers cannot shelter their crops.

Diurnal and annual variations of soil temperature and moisture

Periodic fluctuations of soil temperature are caused by the daily and yearly fluctuations in solar radiation received at the surface. The maximum temperature of the surface is reached when the flow of heat into the soil is exactly equal to the flow outward, and so depends not only on the incoming radiation but also on heat transfer in the soil and in air above the surface. Thus it is not surprising that the incidence of the maximum temperature on the surface occurs some time after local noon. At night the surface usually continues to cool until the fall of temperature is checked by the input of solar radiation after dawn, when the curve of temperature takes an abrupt upward turn. Observations even over a period limited to a calendar year clearly reveal that:

(a) There is a diurnal variation of temperature to a depth of about 0.5m, below which changes become too small to measure with conventional equipment;

(b) This diurnal variation is superimposed on a seasonal variation. Providing there is sufficient depth of soil, the seasonal variation becomes negligibly small at depths between roughly 5 and 20m depending upon the soil type and condition - an average figure of 10m would be reasonable to assume;

(c) Plots of both the daily and the seasonal march of soil temperature shows that:

(i) The amplitude of the fluctuation decreases with increasing depth; typically, it is halved for each 0.1m of descent into the ground.

(ii) With increasing depth, the times at which the maximum and the minimum are registered lag increasingly behind time events at the surface. This is most clearly shown in the annual curve, and least clearly for the diurnal minimum.

(iii) Depending on soil type and structure, soil temperatures remain constant at depths of about 10 metres or more. Ground water with a water table below this depth has a constant temperature, which is approximately the annual mean temperature at the relevant station.

Observations at fixed hours may have a different physical significance according to the time of the year they are taken. At 0.1m depth an observation at 1400 hours (local time) will generally be at, or near, the diurnal maximum. But the minimum is reached some time after sunrise, when the effect of surface warming penetrates downwards and arrests the fall of temperature. Therefore observation made at 0800 hours (local time) will be close to the diurnal minimum in early spring and late autumn - but in summer in temperature latitudes, when sunrise may be at 0400 hours (local time) or earlier, an 0800 hours observation will take place well up on the rising portion of the temperature curve.

In addition to the diurnal and annual courses, temperatures in the upper layers of the soil also show irregular variations due to weather. The exchange of air between atmosphere and soil cannot influence soil temperature much, because of the low density (and hence heat capacity) of air compared with that soil, but the day-to-day variations of radiation are certainly felt in the upper soil.

Also, a sudden fall of soil temperature can be caused by heavy rain or showers. When rain or showers occur, the decrease of the soil temperature in the layers below the water front is more due to the decrease of net radiation than to water. In heavy soils, the percolation speed is only about 0.2-0.3 mm h^{-1}, so only the uppermost soil layers can be cooled directly by rain water. But in sandy soils, where water is able to percolate faster, a cooling effect of rain is frequently measurable, especially after dry spells. The cooling effect of rain lasts often as long as the soil moisture and thus the heat capacity of the soil is changed. The diffusivity for a good moist horticultural soil will be about 0.45mm^2s^{-1}, that for a peat soil about 0.15mm^2s^{-1}, and for dry organic matter 0.l mm^2s^{-1}. In so-called ‘good’ soil, temperature fluctuations reach deeper levels, and more rapidly, than in peaty soils or in organic mulch. Also, given the same net energy at the surface, the surface and near-surface temperature of the dry organic layer (i.e. the layer with poor thermometric conductivity) may reach higher maximum and lower minimum than the ‘good’ soil.

Soil profiles often exhibit markedly different layers. On a daily basis, calculations based on homogeneous soil characteristics may not be useful when, for example, the topsoil has a markedly higher organic content than the subsoil. Similar problems also arise in the analysis of seasonal fluctuations, e.g. when a shallow layer of soil lies on rock, or when a water table occurs at a few metres depth.

When the soil is covered with vegetation, the upper side of the canopy forms a new surface, which absorbs a considerable portion of incoming radiation. The remaining part of radiation goes through the plant cover and is absorbed by the lower leaves, the rest by the soil surface. The radiation reaching the soil surface below a dense plant cover can be diminished to a few per cent of the total. The amount of reduction depends on the so-called 'leaf area index', i.e. the ratio of the whole leaf area (one side) to the soil surface.

Review Exercises:

1**.** Put 15 questions to Text B (part 1) .
2. Write a summary of Text B (part 2) in English.

Text C THE PHYSICAL ENVIRONMENT

The Environment

The environment of plants and animals is the biological and physical system of the medium surrounding them - the biological including microbes, plants, and animals, and the physical including air, soil and water.

Physical medium

Normally, the physical material surrounding crops and livestock is a mixture of air, water, and soil. Air and water are found in the soil; water and soil particles are found in the air. Aeration and soil moisture are phenomena of air and water in the soil, while atmospheric humidity and dust are those of water and soil in the air. The degrees of association of the various constituents comprise different types of physical environments. For example, too much water in a field of crops may cause waterlogging or even a flood, while too little produces drought. Therefore, fundumental concepts of the physical and chemical properties and the interaction of air, water, and soil in association with various forms of energy should be understood.

(a) Air. The air has long been recognized as a colorless, odorless, and tasteless fluid. It is a mixture of gases, present both as single elements and as compounds, and comprises the earth's atmosphere. Some of these gases are inert, others active. The chemical and physical properties of each individual gas differ widely. Information on these can be found in textbooks on physics and chemistry. Here, the composition and distribution of the air in the physical media of crop and livestock will be described briefly.

In the first 3.5 miles above the earth's surface - predominant life-zone, the natural atmosphere is generally fresh but not dry or pure. In this life-zone, the dry atmosphere, when measured by volume, is composed of about 78% nitrogen, 21% oxygen, and 1% of a combination of several chemically inert and rare gases (argon, neon, and helium, etc.), and chemically active trace gases (methane, nitrous oxide, ozone, etc.). The degree of variability depends upon the type of chemical elements

present, in association with the physical conditions of the atmosphere (radiation, temperature, wind, humidity, etc.). Water vapor, for example, is highly variable. It varies from as little as 0.001 to as much as 0.01 percent in a volume of air. When expressed by weight, it varies from few milligrams to 40 grams per kilogram of dry air. Also, its variation with time and space is much greater than any single constituent of the atmospheric air. Other variable constituents are ozone, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, ammonia, carbon monoxide and a few other elements. The major constituents, namely oxygen and nitrogen, are appreciably constant.

Liquid and solid substances of both organic or inorganic compounds are foreign matters of the atmosphere. There are numerous varieties of such foreign matters, ranging from airborne bacteria and fungi to sea-salt particles and ammonium sulfate.

The average composition of air is different under the surface of the soil, in the water, and in the upper atmosphere (about 30 miles above mean sea level). The vertical gaseous exchange between the interface of the atmosphere and its lower boundaries (the soil, water and vegetation) and its upper boundary (the upper atmosphere), goes on constantly within space and time. Much of the gaseous exchange in the lower boundaries involves living organisms. Some of the exchanges are through such physical mechanisms as turbulence and diffusion. All of these exchanges involve matter in gaseous, liquid, and solid states.

Growth and development in plants

It is necessary to differentiate the word “growth” from “development”, for the two differ basically. Growth refers to an increase in weight or volume of a certain organ of a plant, or a plant as a whole, within the time interval of a certain phase or an entire life span. Development is the appearance of a phase or series of phases during a plant’s life cycle. For example, the flowering of a plant is “development”, while the elongation of a stem is “growth”. In considering the plant-growing season, one can recognize that growth is a continuous function and that development is a discontinuous one. With respect to the chemical and physical changes in plant composition, growth gives quantitative changes but not profound qualitative changes. Development, on the other hand, indicates the progress of a series of qualitative changes (with or without external changes) throughout all different stages until death. Thus, it follows that the growth of a plant can be measured by the elongation of stem and shoot, the increase of dry and fresh weight, and so forth; while development is usually observed by the dates of germination, initiation of floral primordia, inflorescence, and fruiting. In other words, a study of the development of a plant is generally morphological and phenological in approach, but that of growth is generally physiological and ecological.

Plant physiologists may consider growth a complex phenomenon and a process hard to define. For growth connotes all and any of these aspects: reproduction, increase in dimensions, gain in weight and cell multiplication, and others. It depends upon the kind of individual organ taken as a measure of growth.

In the case of germinating seeds and sprouting tubers, the total dry weight of the young seedling and seed combined, or of the sprout and tubers, is less than the weight of the original seed or tuber for a short period, due to respiration. However, Miller (1938) has defined growth as a permanent increase in weight, attended by a permanent change in form, induced primarily by an increase in the quantity of protoplasm. In agrometeorology, the best definition of growth is: the increase in weight or dimension of an organ which is most sensitive to environmental changes. In common agricultural practice, vernalization, winter chilling, and the breaking of dormant seeds or buds are problems of development and not growth. When the number of an organ per unit field-area is concerned, it may be considered as either a growth or a development problem, depending upon the kind and stage of the organ. While flower count or fruit count is commonly considered as an indication of the growth, the appearance of the number of leaves at each stage indicates the development. Usually, though physiologically not sound, the number of economic organ available is considered as a growth problem. In short, the number of an organ per unit area is perhaps not a good indicator for differentiating the growth from the development.

The following illustration serves the purpose: Wang (1958, 1960) has studied the morphological development of the subterranean ears of sweet corn at the early vegetative stage in connection with their maturity date. Emphasis was placed in the choice of a significant element out of a group of environmental factors as well as that of a significant period around the seedling stage of sweet corn. A test was set up for ten different sweet corn varieties for a period of 13 years (1938-50) on Ames, Iowa. It was found that the subterranean ears initiated underground on the stem became functioning ears if environmental conditions were favorable. Thus, (a) the time interval for the first 12 days after planting would be the significant period; (b) the soil temperature should be one of the significant elements; and (c) a family of curves, obtained by plotting the mean soil temperature during the significant period against the number of days of growth for each year and for each individual variety, serves as the predictor. In fact, each curve characterizes the varietal differentiation. In short, this method attempts to predict the maturity date of sweet corn about two months or more ahead of time by virtue of the concept of the physiological predetermination through the developmental process. A comparison of this method with that of the heat unit approach has been worked out by Wang (1958); who pointed out that the former is superior to the latter in its accuracy, earliness, and simplicity.

Answer the following questions:

1. Is there any difference between the biological and physical systems of the medium surrounding plants and animals ?
2. What does the physical material surrounding crops and livestock include?
3. What is air ?
4. What is dry atmosphere life-zone composed of ?

5. Does gaseous exchange in the lower boundaries involve living organisms?

6. Is there any difference between the words “growth” and “development”?

7. What does the word "‘growth” refer to ?

8. What does development indicate ?

9. What is the best definition of growth in agrometeorology ?

10. The number of an organ per unit area is not a good indicator for differentiating the growth from the development, is it ?

Text D Plant Diseases and Climate Change

Although research is limited, research has shown that climate change may alter the developmental stages of pathogens that can affect crops. The biggest consequence of climate change on the dispersal of pathogens is that the geographical distribution of hosts and pathogens could shift, which would result in more crop losses. This could affect competition and recovery from disturbances of plants. It has been predicted that the effect of climate change will add a level of complexity to figuring out how to maintain sustainable agriculture.

Observed impacts

Effects of regional climate change on agriculture have been limited. Changes in crop phenology provide important evidence of the response to recent regional climate change. Phenology is the study of natural phenomena that recur periodically, and how these phenomena relate to climate and seasonal changes. A significant advance in phenology has been observed for agriculture and forestry in large parts of the Northern Hemisphere. Droughts have been occurring more frequently because of global warming and they are expected to become more frequent and intense in Africa, southern Europe, the Middle East, most of the Americas, Australia, and Southeast Asia. Their impacts are aggravated because of increased water demand, population growth, urban expansion, and environmental protection efforts in many areas. Droughts result in crop failures and the loss of pasture grazing land for livestock.

Examples

As of the decade starting in 2010, many hot countries have thriving agricultural sectors. Jalgaon district, India, has an average temperature which ranges from 20.2C in December to 29.8C in May, and an average precipitation of 750mm/year.[1321] It produces bananas at a rate that would make it the world's seventh-largest banana producer if it were a country.[1331]

During the period 1990-2012, Nigeria had an average temperature which ranged from a low of 24.9C in January to a high of 30.4C in April.[1341] According to the Food and Agriculture Organization of the United Nations (FAO), Nigeria is by far the world's largest producer of yams, producing over 38 million tonnes in 2012. The second through 8th largest yam producers were all nearby African countries, with the largest non-African producer. Papua New Guinea, producing less than 1% of Nigerian production.[1351]

In 2013, according to the FAO, Brazil and India were by far the world's leading producers of Sugarcane, with a combined production of over 1 billion tonnes, or over half of worldwide production.[1361]

Projections

As part of the IPCC's Fourth Assessment Report, Schneider et al. (2007) projected the potential future effects of climate change on agriculture. With low to medium confidence, they concluded that for about a l to 3 °C global mean temperature increase (by 2100, relative to the 1990-2000 average level) there would be productivity decreases for some cereals in low latitudes, and productivity increases in high latitudes. In the 1PCC Fourth Assessment Report, "low confidence" means that a particular finding has about a 2 out of 10 chance of being correct, based on expert judgement. "Medium confidence" has about a 5 out of 10 chance of being correct. Over the same time period, with medium confidence, global production potential was projected to: increase up to around 3 °C, very likely decrease above about 3 °C.

Most of the studies on global agriculture assessed by Schneider et al. (2007) had not incorporated a number of critical factors, including changes in extreme events, or the spread of pests and diseases. Studies had also not considered the development of specific practices or technologies to aid adaptation to climate change.

The US National Research Council (US NRC, 201 1) assessed the literature on the effects of climate change on crop yields. US NRC (2011) stressed the uncertainties in their projections of changes in crop yields.

Their central estimates of changes in crop yields are shown above. Actual changes in yields may be above or below these central estimates. US NRC (2011)[1401] also provided an estimated the "likely" range of changes in yields. "Likely" means a greater than 67% chance of being correct, based on expert judgement. The likely ranges are summarized in the image descriptions of the two graphs.

Food security

The IPCC Fourth Assessment Report also describes the impact of climate change on food security. Projections suggested that there could be large decreases in hunger globally by 2080, compared to the (then-current) 2006 level.[1431] Reductions in hunger were driven by projected social and economic development. For reference, the Food and Agriculture Organization has estimated that in 2006, the number of people undernourished globally was 820 million.[1441] Three scenarios without climate change (SRESA1, Bl, B2) projected 100-130 million undernourished by the year 2080, while another scenario without climate change (SRES A2) projected 770 million undernourished. Based on an expert assessment of all of the evidence, these projections were thought to have about a 5-in-10 chance of being correct.

The same set of greenhouse gas and socio-economic scenarios were also used in projections that included the effects of climate change. Including climate change, three scenarios projected 100-380 million undernourished by the year

2080, while another scenario with climate change "projected 740-1,300 million undernourished. These projections were thought to have between a 2-in-10 and 5-in-10 chance of being correct.

Projections also suggested regional changes in the global distribution of hunger. By 2080, sub- Saharan Africa may overtake Asia as the world's most food-insecure region. This is mainly due to projected social and economic changes, rather than climate change.

I. Put 20 questions to the text B

II. Make up a plan of text B and retell it in accordance to it.

III. Translate the proverbs and sayings . Give your own situations with them:

1. My stars!
2. Shooting star
3. To believe in one's star
4. How goes the world with you?
5. Not for the world
6. In season and out of season
7. Rush season
8. To be in season
9. Everything is good in its season

GRAMMAR

The Infinitive

RULE_____

Випадки в яких інфінітив вживається
без частки "to":

- *після модальних дієслів;*
- *після дієслів* ***to make*** *та to let;*
- *після виразів:* ***would rather ..., had better ..., would sooner ...;***

_____

у звороті об'єктивний відмінок з інфінітивом" після дієслів ***to see, to watch, to hear, to feel, etc.***

Ex. 1 Вставте частку *"to"* перед інфінітивом, де необхідно:

1. He likes ... play football.
2. She can ... speak English.
3. We let them ... go there.
4. Don't help her ... do it.

5. May I ... take your dictionary?
6. He made me ... do it.
7. Mother let us ... swim in the river.
8. I don't want ... see him.
9. We would rather ... go home.
10. They wanted ... speak to us.
11. Would you like ... drink?
12. You had better ... take this medicine.
13. They couldn't ... find their child.
14. It's time ... go for a walk.
15. I'd like ... believe you.
16. We were ready ... go out.
17. My parent's didn't let me ... go to that party.
18. Do you like ... dance?
19. Would you like ... listen to my song?
20. His joke made me laugh.

Ex. 2 Замініть підкреслені частини речень інфінітивними зворотами.

Ex. He has a lot of books which he can read.
He has a lot of books to read.

1. I would like to offer you the dress which you can buy.
2. Have you chosen the project of the house which you will build?
3. Is there something which you can show us?
4. Here is a man who will do this work.
5. Could you give me a book which I can read?
6. Jack's brought us a new film which we can see.
7. They have a lot of work which they must finish in time.
8. She has less time in which she will tell you everything.
9. Here is an interesting physical process which we can study.
10. Mother bought a lot of fruit which we can eat.
11. You can put on the coat which will warm you.
12. Our teacher gives us many rules which we must learn.
13. Can you give me a pen which I can write with?
14. Here are some proposals which we have to discuss.
15. Has she typed the documents which I will sign?

RULE_____

Форми інфінітива		
	Active	**Passive**
Indefinite	to ask	to be asked

Continuous	to be asking	----
Perfect	to have asked	to have been asked
Perfect Continuous	to have been asking	----

ATTENTION _____

Зверніть увагу на значення різних форм інфінітива!

Active	**Indefinite**	I am (always) glad to help you.	*Я радий (завжди) допомогти вам.*
	Continuous	I am glad to be helping you now.	*Я радий, що допомагаю вам зараз.*
	Perfect	I am glad to have helped you.	*Я радий, що допоміг вам.*
	Perfect Continuous	I am glad to have been helping you since morning.	*Я радий, що допо магаю вам з ранку.*
Passive	**Indefinite**	I am (always) glad to be helped.	*Я (завжди) радий, коли мені допомагають.*
	Perfect	I am glad to have been helped.	*Я радий, що мені допомогли.*

Ex. 3 Перекладіть українською мовою, звертаючи увагу на *Active Infinitive* та *Passive Infinitive.*

1. I am glad to meet him.
2. He was glad to be met at the station.
3. She is sorry to tell you about it.
4. She didn't want to be told about it.
5. The child doesn't like to be punished.
6. To buy a new dress is her only dream.
7. He wanted to be invited to this party.
8. We hope to be sent to the conference.
9. I have a great desire to spend next summer in Paris.
10. Nobody wants to be laughed at.

Ex. 4 Замініть підкреслені частини речень *Perfect Infinitive.* Перекладіть українською.

1. He is sorry that he has said it.
2. She is glad that she has received his letter.
3. Tom was happy that he had been taken to the zoo.
4. I remember that I had met this woman before.

5. Susan is sorry that she has spoilt mv picture.
6. I wasn't glad because I had been appointed to the post of manager.
7. He was angry because he had been interrupted.
8. The pupils are in a good mood as they have written the 1 test without mistakes.
9. The boy was sorry because he had forgotten Loi's book at home.
10. We are glad that we have been invited to the party.
11. She is very happy as she has achieved her aim.
12. He is very upset because he has not passed his exam.

Ex. 5 Перекладіть англійською, вживаючи відповідну форму інфінітива.

1. Він вирішив не дзвонити їй.
2. Ми думаємо не залишатися тут до кінця лекції.
3. Здається, зараз іде сніг.
4. Вона вирішила не робити цього.
5. Він любить розповідати смішні історії.
6. Він любить, коли йому розповідають смішні історії.
7. Він задоволений, що йому розповіли цю історію.
8. Я зупинився, щоб подивитись на гру самодіяльних артистів.
9. Приємно було знову плавати в морі.
10. Здавалося, що іде дощ.
11. Я сподівався бути запрошеним на їхнє весілля.
12. Він був задоволений, що відповів на всі питання.
13. Мені приємно розмовляти з тобою зараз.
14. Мені завжди приємно розмовляти з тобою.
15. Вона не любить, коли за нею спостерігають під час роботи.

REMEMBER_____

Запам'ятайте!

Complex Object *складається з іменника у загальному відмінку або займеника в об'єктивному відмінку та інфінітива як дійсного, так і пасивного стану:*

I like him to dance.
Мені подобається як він танцює.
I want you to give me this book.
Я хочу, щоб ти дав мені цю книжку.

Українською мовою ***Complex Object*** *найчастіше перекладається підрядним додатковим реченням*

RULE_____

Complex Object *вживається після дієслів, що виражають бажання, почуття:*

to want	**to like**	**to desire**
to wish	**to hate**	**should (would) like**

Ex.6 Перекладіть англійською мовою, вживаючи *Complex Object.*

1. Я хочу, щоб ти допоміг мені.
2. Батько хотів, щоб я прочитав цю книжку.
3. Мені б хотілось, щоб вони приїхали до мене.
4. Вона хотіла, щоб його запросили на вечірку.
5. Я терпіти не можу, коли ти запізнюєшся.
6. Ми хочемо, щоб він заспівав цю пісню.
7. Мої батьки не хотіли б, щоб я отримував погані оцінки.
8. Він хотів би, щоб ти не казав цього.
9. Вона бажає, щоб тільки ви приносили їй каву.
10. Я не хочу, щоб вони знали про це.
11. Вчитель хоче, щоб учні не переривали його.
12. Мій друг не хоче, щоб я заплатив за обід.
13. Кожен вчитель хоче, щоб його учні вчилися добре.

Complex Object *вживається після дієслів, що виражають припущення:*

to expect	**to suppose**	**to think**
to consider	**to believe**	**to fin**

Та після дієслів:

to know	**to imagine**	**to declare**

We know him **to be** a kind man.
Ми знаємо, що він добра людина.

Ex. 7 Перекладіть англійською мовою, використовуючи *Complex Object.*

1. Всі вважають його чесною людиною.
2. Хлопчик чекав, що батьки похвалять його.
3. Я припускаю, що вона не знає про це.
4. Ми очікували, що вам допоможуть. Вона вважає, що ти права.
5. Я чекав, що відповідь надішлють одразу.
6. Я вважаю, що вони зараз в Києві.
7. Ми припускаємо, що снігопад відрізав їх від міста.
8. Вчені вважають, що ці досліди є небезпечними.
9. Ми вважаємо, що вона найкраща учениця.
10. Всі сподівались, що корабель прибуде вчасно.
11. Він не вважає мене лінивим!
12. Я припускав, що їй приблизно тридцять.
13. М. Ми вважали його досить хороброю людиною.
14. Ти припускаєш, що вони повернуться за тиждень?
15. Не вважайте його брехуном.
16. Я навіть не припускав, що їхня команда переможе.
17. Чому він вважає, що я зрозумію його проблеми?

***Complex Object** вживається після дієслів, ’що виражають наказ, прохання, дозвіл, пораду:*

to order to advice to request to command
to recommend to ask for to allow to permit

I asked **for the telegram to be sent** at once.

Я попросив, щоб телеграму відправили негайно.

***Complex Object** вживаєтьсяв таких конструкціях:*

To make somebody do something
To let somebody do something
To have somebody do something

RULE_____

Зверніть увагу!
Зворот з інфінітивом виражає, в більшості випадків, закінчену дію.
Зворот з дієприкметником виражає дію, що триває.
Порівняйте:
I saw her **enter** the room.
Я бачив, як вона увійшла до кімнати.
I saw her **entering** the room.
Я бачив, як вона входила до кімнати.

Ex. 8 Перекладіть англійською мовою, використовуючи *Complex Object.*

1. Вони наказали, щоб їхні речі принесли в номер.
2. Менеджер порадив, щоб я взяв кредит.
3. Він не дозволив, щоб товари зберігали в крамниці.
4. Вчитель дозволив їм користуватись словником.
5. Вона не просила, щоб документи відправили.
6. Ми не дозволяємо, щоб меблі псували.
7. Його батько наказав, щоб помили підлогу.
8. Офіцер наказав, щоб почистили зброю.
9. Я не просив, щоб квіти поливали так часто.
10. Вона просить, щоб валізи поставили в машину.

Після дієслів, що виражають сприйняття, може вживатись також ***Об'єктний Дієприкметниковий комплекс (The Objective Participle Complex).*** *Українською він перекладається підрядним реченням.*
The Objective Participle Complex *складається з іменника в загальному відмінку або займенника в об'єктному відмінку та Present Participle.*

Ex. 9 Перефразуйте речення, використовуючи *Complex Object* з дієприкметником.

1. They were playing football. We watched them.
2. He was going along the street. I saw him.
3. She was telling lie. We heard it.
4. They were dancing. I didn't see them.
5. The wind was getting stronger. He felt it.

6. The two man were laughing at him. He noticed it.
7. My grandmother was sitting in the arm-chair. I saw her.
8. Somebody was touching his hand. He felt it.
9. The man was getting angry. We felt it.
10. Children were playing with a dog. Did you see them?
11. His wife was washing up. He watched her.
12. The typist was typing a letter. I watched her.

Ex. 10 Перекладіть англійською мовою, використовую^ *Complex Object* з дієприкметником.

1. Всі чули, як він виголошував промову.
2. Вона спостерігала, як небо темніло.
3. Я бачив, як він пішов в напрямку станції.
4. Ми спостерігали, як дослідник проводить експеримтг»,
5. Він бачив, як вона закривала крамницю.
6. Ти любиш спостерігати, як падають сніжинки?
7. Дівчина відчула, як сльози котяться по її щоках. 1
8. Ти коли-небудь спостерігав, як граються дельфіни?
9. Я почув, як хтось співає в сусідній кімнаті.
10. Ми часто спостерігали, як бавляться маленькі звірят у зоопарку.
11. Ви бачили, як розлилась ріка?
12. Стоячи біля вікна, вона спостерігала, як вітер грім сухим листям.
13. Ти коли-небудь бачила, як кіт ловить мишу?
14. Я спостерігав, як птахи відлітають на південь.

Ex. 11 Перекладіть англійською мовою, використовуючи *Complex Object* з інфінітивом або дієприкметником, де необхідно.

1. Студенти спостерігали, як професор передивляється свої папери.
2. Я помітив, що він уважно слухає мене.
3. .4. Ми не бачили, як гелікоптер піднявся і полетів.
4. *А.* Я щойно почув, як хтось закричав.
5. Вона спостерігала, як її мати шила сукню.
6. (і. Глядачі побачили, як спортсмени кинулися вперед.
7. Я бачив, як мій сусід рибалив.
8. Хлопчик спостерігав, як його тітка шукає свої окуляри, і). Він відчув, як товариш обіймає його за плечі.
9. Ти бачиш цю дівчину, що посміхається тобі?
11. Ми почули, що хтось біжить за нами.
10. Я відчув, як моє серце б’ється від щастя.
11. Він побачив, що хвилі віднесли пліт у море.
12. Він помітив, як хлопець підняв її хустку.
13. Я бачив, як вони вечеряли в ресторані.
14. Вона відчула, що хлопчик дивиться на неї із здивуванням.

15. Генрі бачив, як він повернув направо.
16. Ми почули, як ви попереджали їх про небезпеку.
17. Я ніколи не чув, як грає цей відомий музикант.
18. Я спостерігав, як журналісти задавали питання депутату.
19. Ми спостерігали, як розвантажували товари.

Ex. 12 Перекладіть англійською мовою, використовуючи *Complex Object* з інфінітивом або дієприкметником.

Я ніколи не чув,	як вони співають.
	як він розповідає вірші, як вона грає на скрипці, щоб хлопчик плакав, щоб вони сварились.
Ти чув,	як хтось постукав у двері?
	як він вийшов з кімнати? як я відповів на твоє питання?
	як пішов дощ?
Вона бачила,	як під'їхав автомобіль.
	як він допоміг вам. як зійшов місяць, як хлопець підняв очі. як відходив поїзд, що ти працював в саду, що ви спостерігали за нею. як мерехтіли зорі, як ми перепливали річку.

Зверніть увагу!

Коли у звороті ***Complex Object*** *з* ***Past Participle*** *вживається дієслово* ***to have****, це означає, що дію виконує не особа, означена підметом, а хтось інший для неї або за неї.*

Він (сам) відремонтував свою машину.
He mended his car.
Він відремонтував (віддав в ремонт) свою машину.
He had his car mended.

Ex.13 Перекладіть англійською мовою, використовуючи *Complex Object* з *Past Participle.*

1. Я хочу підстригти волосся.
2. Він хоче відремонтувати автомобіль.
3. Вона збирається відремонтувати взуття.
4. Ми ще не відремонтували телевізор.
5. Вони збирались сфотографуватися.
6. Ти відремонтував годинник?
7. Я не хочу підстригати волосся.
8. Він повинен сьогодні підстригтися.
9. Вони збираються зрізати дерева в садку?
10. Вона хотіла пошити собі нову сукню.

11. Ти шиєш тут одяг?
12. Ми повинні негайно відремонтувати телефон.
13. Ця жінка не хоче підстригати волосся, вона хоче зробити зачіску.
14. Він щойно сфотографувався.
15. Ми не збиралися ремонтувати холодильник, але тепер змушені.

Ex. 14 Перекладіть англійською мовою, використовуючи *Complex Object.*

1. Ми хотіли, щоб носій відніс багаж до машини.
2. Він терпіти не може, коли ти з ним сперечаєшся.
3. Ми думаємо, їй років сімдесят.
4. Я хочу пошити довгу чорну сукню для вечірок.
5. Я поговорю з ними і постараюсь змінити їхнє до тебе ставлення.
6. Хлопчик любить спостерігати, як плавають рибки в акваріумі.
7. Терпіти не можу, коли ти повторюєш ці нісенітниці.
8. Вона хоче, щоб повернули їй прикраси.
9. Я бачив, як вона піднімалась східцями, але не бачив, в які двері зайшла.
10. Ви б хотіли, щоб він надіслав вам листівку?
11. Дуже цікаво спостерігати, як граються цуценята.
12. Він завжди вважає себе правим.
13. Вона дозволила дітям купити морозиво.
14. Було б добре, якби паспорти видали до вечора.
15. Я не знаю, чому він не збирається ремонтувати наш автомобіль.
16. Дивний шум за спиною змусив її обернутись.

Ex. 15 Перекладіть англійською мовою, використовуючи *Complex Object.*

1. Я бачив, як він намагається пригадати все.
2. Люди спостерігали, як палає будинок.
3. Ми вважаємо цю теорію помилковою.
4. Що змушує вас так поспішати?
5. Я вважаю його слова дуже брутальними.
6. Ми сподіваємось, що він стане умілим художником.
7. Всі уважно слухали, як професор робив доповідь.
8. Вони хотіли, щоб я заспівав ще одну пісню.
9. Я не вважаю, що це змусить їх залишитися в країні.
10. Ніхто не бачив, як він упав і зламав руку.
11. Чому ти не примушуєш дитину займатися спортом?
12. Ми вважали, що він хворий, але ми помилялися.
13. Не дозволяй дітям виходити надвір, там дуже холодно.
14. Ніщо не може змусити нас змінити наші плани.
15. Я не помітив, як він підслуховував нашу розмову.
16. Ми бачили, як репортери дістали камери і почали знімати.
17. Вона зовсім не почула, як хтось вкрав у неї гаманець.
18. Ми бачили, як літак пролетів над містом.

19.Ми почули, як мама покликала нас.
20.Дівчинка побачила, як бабуся закрила вікно.
21.Всі почули, як він раптом заговорив гучним голосом.
22.Чому ти не любиш, коли люди розмовляють надто голосно?

Complex Subject *складається:*
Перша частина *— з іменника в загальному відмінку або займенника в називному відмінку.* ***Друга частина*** *— з інфінітива у відповідній формі.* *Обидві частини відокремлені присудком.* He is **said to live** in Kyiv. *Говорять, що він живе в Києві.*
They are known **to be** good pupils. *Відомо, що вони гарні учні.* **They** were known **to be** good pupils. *Було відомо, що вони гарні учні.*
She is said **to have left** Kyiv. *Говорять, що вона поїхала з Києва.* **She** was said **to have left** Kyiv. *Говорили, що вона поїхала з Києва.*
Complex Subject *вживається, коли присудок виражено такими дієсловами, що стоять в Passive Voice:* to say to hear to expect to state to announce to know to suppose to believe to understand to see to think to consider to order to ask to allow **We** were asked **to wait** in the office. *Нас попросили зачекати в офісі.* **They** are supposed **to come** at seven. *Припускають, що вони приїдуть о сьомій.*

Ex. 16 Перекладіть українською мовою, звертаючи увагу на *Complex Subject.*

1. She is said to be a very kind woman.
2. He is considered to have finished his scientific researches.
3. What are they supposed to be doing?
4. Children were supposed to have stayed in the country- house.
5. This student is believed to know four foreign languages.
6. She is believed to have been instructed about everything.

7. He was believed to be preparing a report.
8. The new invention is considered to be applied in some days.
9. They aren't supposed to take part in this conference.
10. What am I expected to answer?

Ex. 17 Перекладіть українською мовою, використовуючи *Complex Subject.*

1. My work is considered to be finished in some hours.
2. You are supposed to have told the truth.
3. His parents were not expected to come so early.
4. The pupils are not considered to know the answers to these questions.
5. What are they expected to do now?
6. My friends are believed to be on their way to my place.
7. Do you know the ship is reported to call in the port tomorrow?
8. Isn't he considered to be one of the best surgeons?
9. Her father was known to have been appointed to this post.
10. These plants are known to grow in subtropics.
11. She was heard to have left for France.
12. Who is considered to be the best specialist in this field of science?
13. The documents are reported to have been received.
14. They are said to have been travelling for a long time.
15. These reforms are thought to be difficult to carry out.
16. The train can be expected to arrive at seven.

Ex. 18 Перекладіть англійською мовою, використовуючи *Complex Subject.*

1. Цю рослину вважають отруйною.
2. Говорять, що Джейн знає все про життя тварин.
3. Відомо, що цей співак дуже популярний серед підлітків.
4. Виявилось, що він змінив адресу.
5. Не чекали, що він так швидко піде вгору.
6. Відомо, що ця експедиція проводить розкопки вже тривалий час.
7. Припускають, що результати їхніх дослідів виявлять незадовільними.
8. Було відомо, що будівлю зруйнували під час війни.
9. Кажуть, він досяг великого успіху в спорті.
10. Не можна очікувати, що ваші умови приймуть.
11. Якщо він цього не зробить, його вважатимуть нечесною людиною.
12. Очікують, що цей фільм отримає багато нагород на фестивалі.
13. Думаю, що він зараз працює в бібліотеці.
14. Говорять, що клімат на землі стає теплішим.
15. Допускають, що будівництво нової школи завершиться до першого вересня.

Complex Subject *вживається, коли присудок виражено такими дієсловами, що стоять в Active Voice:*

to seem	to happen	to appear
to chance	to prove	to turn out

He seems **to notice** nothing unusual.
Здається, він не помічає нічого дивного.
They seem **to have forgotten** their promise.
Здавалось, вони забули про свою обіцянку

Ex. 19 Перекладіть англійською мовою, використовуючи *Complex Subject.*

1. Кажуть, що ви вже переїхали до нового будинку.
2. Здавалось, що він вже думає над цією проблемою.
3. Виявляється, що новий проект успішно втілюється І життя.
4. Думали, що зустріч відбудеться у травні.
5. Виявилось, що вони ніколи не були в Японії.
6. Чули, що експедиція вже повернулась додому?
7. Повідомляють, що погода протягом доби не зміниться.
8. Здається, він розмовляє зі своєю мамою.
9. Земля виявилась родючою.
10. Вважають, що парниковий ефект робить клімат Землі теплішим.

Ex. 20 Перекладіть українською мовою, використовуючи *Complex Subject.*

1. She is likely to get upset if you ask about it.
2. Their work is certain to take a long time.
3. Jane is not sure to obtain information from the article.
4. She is sure to call while I am out.
5. This question is certain to be discussed.
6. The results of you examination are likely to be known in a day.
7. They are sure to welcome us warmly.
8. We were not likely to finish our research before the end of the month.
9. Her brother is not likely to help us.
10. He is sure to be attractive, but I am not interested.

Ex. 12 Перекладіть англійською мовою, використовую *Complex Subject.*

1. Кажуть, що його дослідження відомі в усьому світі.
2. Поїздка виявилась нецікавою.
3. Здається, вона рідко виходить з дому.
4. Не чекали, що вони поїдуть на цьому тижні.

5. Ми дізналися про правду випадково.
6. Виявилось, що всі необхідні приготування до вечірки зроблено.
7. Здавалося, що він не жалкує про сказане.
8. Виявляється, що ця жінка не лікар.
9. Можливо, вони вже повідомили батькам своє рішення.
10. Говорять, що виставку робіт молодих художників відкриють дуже скоро.
11. Ти часом не знаєш її адресу?
12. Вона, здається, працює над цим перекладом вже три дні.
13. Здається, цей чоловік завжди в гарному настрої.
14. Говорять, що він вже вийшов на пенсію.
15. Виявилось, що наших листів не отримали.

LESSON 3

OCEANOGRAPHY

INTRODUCTION

Oceanography (compound of the Greek words ὠκεανός meaning "ocean" and γράφω meaning "write"), also known as oceanology, is the study of the physical and biological aspects of the ocean. It is an Earth science, which covers a wide range of topics, including ecosystem dynamics; ocean currents, waves, and geophysical fluid dynamics; plate tectonics and the geology of the sea floor; and fluxes of various chemical substances and physical properties within the ocean and across its boundaries.

These diverse topics reflect multiple disciplines that oceanographers blend to further knowledge of the world ocean and understanding of processes within: astronomy, biology, chemistry, climatology, geography, geology, hydrolog y, meteorology and physics. Paleoceanography studies the history of the oceans in the geologic past.

Earth science or geoscience includes all fields of natural science related to the planetEarth. It is the branch of science dealing with the physical constitution of the Earth and its atmosphere. Earth science is the study of our planet’s physical characteristics, from earthquakes to raindrops, and floods to fossils. Earth science can be considered to be a branch of planetary science, but with a much older history. Earth science encompasses four main branches of study, the lithosphere, the hydrosphere, the atmosphere, and the biosphere, each of which is further broken down into more specialized fields.

An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system. These biotic and abiotic components are linked together through nutrient cycles and energy flows. Energy enters the system through photosynthesis and is

incorporated into plant tissue. By feeding on plants and on one-another, animals play an important role in the movement of matter and energy through the system. They also influence the quantity of plant and microbial biomass present. By breaking down dead organic matter, decomposers release carbon back to the atmosphere and facilitate nutrient cycling by converting nutrients stored in dead biomass back to a form that can be readily used by plants and other microbes.

An **ocean current** is a continuous, directed movement of sea water generated by a number of forces acting upon the water, including wind, the Coriolis effect, breaking waves, cabbeling, and temperature and salinity differences. Depth contours, shoreline configurations, and interactions with other currents influence a current's direction and strength. Ocean currents are primarily horizontal water movements.

The **World Ocean** or **Global Ocean** (colloquially the sea or the ocean) is the interconnected system of Earth's oceanic waters, and comprises the bulk of the hydrosphere, covering 361,132,000 square kilometres (139,434,000 sq mi) (70.8%) of Earth's surface, with a total volume of roughly 1,332,000,000 cubic kilometres (320,000,000 cu mi).

Paleoceanography is the study of the history of the oceans in the geologic past with regard to circulation, chemistry, biology, geology and patterns of sedimentation and biological productivity. Paleoceanographic studies using environment models and different proxies enable the scientific community to assess the role of the oceanic processes in the global climate by the re-construction of past climate at various intervals. Paleoceanographic research is also intimately tied to paleoclimatology.

Text A.

Modern oceanography

Despite all this, human knowledge of the oceans remained confined to the topmost few fathoms of the water and a small amount of the bottom, mainly in shallow areas. Almost nothing was known of the ocean depths. The British Royal Navy's efforts to chart all of the world's coastlines in the mid-19th century reinforced the vague idea that most of the ocean was very deep, although little more was known. As exploration ignited both popular and scientific interest in the polar regions and Africa, so too did the mysteries of the unexplored oceans.

The seminal event in the founding of the modern science of oceanography was the 1872–1876 *Challenger* expedition. As the first true oceanographic cruise, this expedition laid the groundwork for an entire academic and research discipline.[5] In response to a recommendation from the Royal Society, the British Government announced in 1871 an expedition to explore world's oceans and conduct appropriate scientific investigation. Charles Wyville Thompson and Sir John Murray launched the *Challenger* expedition. *Challenger*, leased from the

Royal Navy, was modified for scientific work and equipped with separate laboratories for natural history and chemistry. Under the scientific supervision of Thomson, *Challenger* travelled nearly 70,000 nautical miles (130,000 km) surveying and exploring. On her journey circumnavigating the globe, 492 deep sea soundings, 133 bottom dredges, 151 open water trawls and 263 serial water temperature observations were taken. Around 4,700 new species of marine life were discovered. The result was the *Report Of The Scientific Results of the Exploring Voyage of H.M.S. Challenger during the years 1873–76*. Murray, who supervised the publication, described the report as "the greatest advance in the knowledge of our planet since the celebrated discoveries of the fifteenth and sixteenth centuries". He went on to found the academic discipline of oceanography at the University of Edinburgh, which remained the centre for oceanographic research well into the 20th century. Murray was the first to study marine trenches and in particular the Mid-Atlantic Ridge, and map the sedimentary deposits in the oceans. He tried to map out the world's ocean currents based on salinity and temperature observations, and was the first to correctly understand the nature of coral reef development.

In the late 19th century, other Western nations also sent out scientific expeditions (as did private individuals and institutions). The first purpose built oceanographic ship, *Albatros*, was built in 1882. In 1893, Fridtjof Nansen allowed his ship, *Fram*, to be frozen in the Arctic ice. This enabled him to obtain oceanographic, meteorological and astronomical data at a stationary spot over an extended period.

In 1881 the geographer John Francon Williams published a seminal book, *Geography of the Oceans*. Between 1907 and 1911 Otto Krümmel published the *Handbuch der Ozeanographie*, which became influential in awakening public interest in oceanography. The four-month 1910 North Atlantic expedition headed by John Murray and Johan Hjort was the most ambitious research oceanographic and marine zoological project ever mounted until then, and led to the classic 1912 book *The Depths of the Ocean*.

The first acoustic measurement of sea depth was made in 1914. Between 1925 and 1927 the "Meteor" expedition gathered 70,000 ocean depth measurements using an echo sounder, surveying the Mid-Atlantic ridge.

Sverdrup, Johnson and Fleming published *The Oceans* in 1942, which was a major landmark. *The Sea* (in three volumes, covering physical oceanography, seawater and geology) edited by M.N. Hill was published in 1962, while Rhodes Fairbridge's *Encyclopedia of Oceanography* was published in 1966.

The Great Global Rift, running along the Mid Atlantic Ridge, was discovered by Maurice Ewing and Bruce Heezen in 1953; in 1954 a mountain range under the Arctic Ocean was found by the Arctic Institute of the USSR. The theory of seafloor spreading was developed in 1960 by Harry Hammond Hess. The Ocean Drilling Program started in 1966. Deep sea vents were discovered in 1977 by Jack Corliss and Robert Ballard in the submersible DSV *Alvin*.

In the 1950s, Auguste Piccard invented the bathyscaphe and used the bathyscaphe *Trieste* to investigate the ocean's depths. The United States nuclear submarine *Nautilus* made the first journey under the ice to the North Pole in 1958. In 1962 the FLIP (Floating Instrument Platform), a 355-foot (108 m) spar buoy, was first deployed.

From the 1970s, there has been much emphasis on the application of large scale computers to oceanography to allow numerical predictions of ocean conditions and as a part of overall environmental change prediction. An oceanographic buoy array was established in the Pacific to allow prediction of El Niño events.

1990 saw the start of the World Ocean Circulation Experiment (WOCE) which continued until 2002. Geosat seafloor mapping data became available in 1995.

In recent years studies advanced particular knowledge on ocean acidification, ocean heat content, ocean currents, the El Niño phenomenon, mapping of methane hydrate deposits, the carbon cycle, coastal erosion, weathering and climate feedbacks in regards to climate change interactions.

Study of the oceans is linked to understanding global climate changes, potential global warming and related biosphere concerns. The atmosphere and ocean are linked because of evaporation and precipitation as well as thermal flux (and solar insolation). Wind stress is a major driver of ocean currents while the ocean is a sink for atmospheric carbon dioxide. All these factors relate to the ocean's biogeochemical setup.

Branches

The study of oceanography is divided into these four branches:

- Biological oceanography, or marine biology, investigates the ecology of marine organisms in the context of the physical, chemical and geological characteristics of their ocean environment and the biology of individual marine organisms.
- Chemical oceanography and ocean chemistry, are the study of the chemistry of the ocean. Whereas chemical oceanography is primarily occupied with the study and understanding of seawater properties and its changes, ocean chemistry focuses primarily on the geochemical cycles.
- Geological oceanography, or marine geology, is the study of the geology of the ocean floor including plate tectonics and paleoceanography.
- Physical oceanography, or marine physics, studies the ocean's physical attributes including temperature-salinity structure, mixing, surface waves, internal waves, surface tides, internal tides, and currents.

Ocean acidification describes the decrease in ocean pH that is caused by anthropogenic carbon dioxide (CO_2) emissions into the atmosphere. Seawater is slightly alkaline and had a preindustrial pH of about 8.2. More recently, anthropogenic activities have steadily increased the carbon dioxide content of the atmosphere; about 30–40% of the added CO_2 is absorbed by the oceans,

forming carbonic acid and lowering the pH (now below 8.1) through ocean acidification. The pH is expected to reach 7.7 by the year 2100.

An important element for the skeletons of marine animals is calcium, but calcium carbonate becomes more soluble with pressure, so carbonate shells and skeletons dissolve below the carbonate compensation depth. Calcium carbonate becomes more soluble at lower pH, so ocean acidification is likely to affect marine organisms with calcareous shells, such as oysters, clams, sea urchins and corals, and the carbonate compensation depth will rise closer to the sea surface.

The current rate of ocean chemistry change seems to be unprecedented in Earth's geological history, making it unclear how well marine ecosystems will adapt to the shifting conditions of the near future. Of particular concern is the manner in which the combination of acidification with the expected additional stressors of higher temperatures and lower oxygen levels will impact the seas.

Answer the questions:

1. When did modern oceanography start? What were the first oceanological expeditions?
2. What are the main branches of oceanography?
3. What does ocean acidification describe?
4. Summarize the text in several sentences.

Text B

Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO_2) from the atmosphere. Seawater is slightly basic (meaning pH > 7), and ocean acidification involves a shift towards pH-neutral conditions rather than a transition to acidic conditions (pH < 7). An estimated 30–40% of the carbon dioxide from human activity released into the atmosphere dissolves into oceans, rivers and lakes. To achieve chemical equilibrium, some of it reacts with the water to form carbonic acid. Some of the resulting carbonic acid molecules dissociate into a bicarbonate ion and a hydrogen ion, thus increasing ocean acidity (H^+ ion concentration). Between 1751 and 1996, surface ocean pH is estimated to have decreased from approximately 8.25 to 8.14, representing an increase of almost 30% in H^+ ion concentration in the world's oceans. Earth System Models project that, within the last decade, ocean acidity exceeded historical analogues and, in combination with other ocean biogeochemical changes, could undermine the functioning of marine ecosystems and disrupt the provision of many goods and services associated with the ocean beginning as early as 2100.

Increasing acidity is thought to have a range of potentially harmful consequences for marine organisms, such as depressing metabolic rates and

immune responses in some organisms, and causing coral bleaching. By increasing the presence of free hydrogen ions, the additional carbonic acid that forms in the oceans ultimately results in the conversion of carbonate ions into bicarbonate ions. Ocean alkalinity (roughly equal to $[HCO_3^-] + 2[CO_3^{2-}]$) is not changed by the process, or may increase over long time periods due to carbonate dissolution. This net decrease in the amount of carbonate ions available may make it more difficult for marine calcifying organisms, such as coral and some plankton, to form biogenic calcium carbonate, and such structures become vulnerable to dissolution. Ongoing acidification of the oceans may threaten future food chains linked with the oceans. As members of the InterAcademy Panel, 105 science academies have issued a statement on ocean acidification recommending that by 2050, global CO_2emissions be reduced by at least 50% compared to the 1990 level.

While ongoing ocean acidification is at least partially anthropogenic in origin, it has occurred previously in Earth's history. The most notable example is the Paleocene-Eocene Thermal Maximum (PETM), which occurred approximately 56 million years ago when massive amounts of carbon entered the ocean and atmosphere, and led to the dissolution of carbonate sediments in all ocean basins.

Ocean acidification has been compared to anthropogenic climate change and called the "evil twin of global warming" and "the other CO_2problem". Freshwater bodies also appear to be acidifying, although this is a more complex and less obvious phenomenon.

Acidification

Dissolving CO in seawater increases the hydrogen ion (H^+) concentration in the ocean, and thus decreases ocean pH, as follows:

$$CO_{2\ (aq)} + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons HCO_3^- + H^+ \rightleftharpoons CO_3^{2-} + 2\ H^+.$$

Since the industrial revolution began, the ocean has absorbed about a third of the CO_2 we have produced since then and it is estimated that surface ocean pH has dropped by slightly more than 0.1 units on the logarithmic scale of pH, representing about a 29% increase in H^+. It is expected to drop by a further 0.3 to 0.5 pH units (an additional doubling to tripling of today's post-industrial acid concentrations) by 2100 as the oceans absorb more anthropogenic CO_2, the impacts being most severe for coral reefs and the Southern Ocean. These changes are predicted to accelerate as more anthropogenic CO_2 is released to the atmosphere and taken up by the oceans. The degree of change to ocean chemistry, including ocean pH, will depend on the mitigation and emissions pathways taken by society.

Although the largest changes are expected in the future, a report from NOAA scientists found large quantities of water undersaturated in aragonite are already upwelling close to the Pacific continental shelf area of North America. Continental shelves play an important role in marine ecosystems since most marine organisms live or are spawned there, and though the study only dealt with the area from Vancouver to Northern California, the authors suggest that other shelf areas may be experiencing similar effects.

Possible impacts

Increasing acidity has possibly harmful consequences, such as depressing metabolic rates in jumbo squid, depressing the immune responses of blue mussels, and coral bleaching. However it may benefit some species, for example increasing the growth rate of the sea star, *Pisaster ochraceus*, while shelled plankton species may flourish in altered oceans.

The report "Ocean Acidification Summary for Policymakers 2013" describes research findings and possible impacts.

Impacts on oceanic calcifying organisms

Although the natural absorption of CO_2 by the world's oceans helps mitigate the climatic effects of anthropogenic emissions of CO_2, it is believed that the resulting decrease in pH will have negative consequences, primarily for oceanic calcifying organisms. These span the food chain from autotrophs to heterotrophs and include organisms such as coccolithophores, corals, foraminifera, echinoderms, crustaceans and molluscs. As described above, under normal conditions, calcite and aragonite are stable in surface waters since the carbonate ion is at supersaturating concentrations. However, as ocean pH falls, the concentration of carbonate ions required for saturation to occur increases, and when carbonate becomes undersaturated, structures made of calcium carbonate are vulnerable to dissolution. Therefore, even if there is no change in the rate of calcification, the rate of dissolution of calcareous material increases.

The Royal Society published a comprehensive overview of ocean acidification, and its potential consequences, in June 2005. However, some studies have found different response to ocean acidification, with coccolithophore calcification and photosynthesis both increasing under elevated atmospheric pCO_2, an equal decline in primary production and calcification in response to elevated CO_2 or the direction of the response varying between species. A study in 2008 examining a sediment core from the North Atlantic found that while the species composition of coccolithophorids has remained unchanged for the industrial period 1780 to 2004, the calcification of coccoliths has increased by up to 40% during the same time. A 2010 study from Stony Brook Universitysuggested that while some areas are overharvested and other fishing grounds are being restored, because of ocean acidification it may be impossible to bring back many previous shellfish populations. While the full ecological consequences of these changes in calcification are still uncertain, it appears likely that many calcifying species will be adversely affected.

When exposed in experiments to pH reduced by 0.2 to 0.4, larvae of a temperate brittlestar, a relative of the common sea star, fewer than 0.1 percent survived more than eight days. There is also a suggestion that a decline in the coccolithophores may have secondary effects on climate, contributing to global warming by decreasing the Earth's albedo via their effects on oceanic cloud cover. All marine ecosystems on Earth will be exposed to changes in acidification and several other ocean biogeochemical changes.

The fluid in the internal compartments where corals grow their exoskeleton is also extremely important for calcification growth. When the saturation rate of aragonite in the external seawater is at ambient levels, the corals will grow their aragonite crystals rapidly in their internal compartments, hence their exoskeleton grows rapidly. If the level of aragonite in the external seawater is lower than the ambient level, the corals have to work harder to maintain the right balance in the internal compartment. When that happens, the process of growing the crystals slows down, and this slows down the rate of how much their exoskeleton is growing. Depending on how much aragonite is in the surrounding water, the corals may even stop growing because the levels of aragonite are too low to pump into the internal compartment. They could even dissolve faster than they can make the crystals to their skeleton, depending on the aragonite levels in the surrounding water. Under the current progression of carbon emissions, around 70% of North Atlantic cold-water corals will be living in corrosive waters by 2050-60.

A study conducted by the Woods Hole Oceanographic Institution in January 2018 showed that the skeletal growth of corals under acidified conditions is primarily affected by a reduced capacity to build dense exoskeletons, rather than affecting the linear extension of the exoskeleton. Using Global Climate Models, they show that the density of some species of corals could be reduced by over 20% by the end of this century.

An *in situ* experiment on a 400 m^2 patch of the Great Barrier Reef to decrease seawater CO_2 level (raise pH) to close to the preindustrial value showed a 7% increase in net calcification. A similar experiment to raise *in situ* seawater seawater CO_2 level (lower pH) to a level expected soon after the middle of this century found that net calcification decreased 34%.

Ocean acidification may force some organisms to reallocate resources away from productive endpoints such as growth in order to maintain calcification.

In some places carbon dioxide bubbles out from the sea floor, locally changing the pH and other aspects of the chemistry of the seawater. Studies of these carbon dioxide seeps have documented a variety of responses by different organisms. Coral reef communities located near carbon dioxide seeps are of particular interest because of the sensitivity of some corals species to acidification. In Papua New Guinea, declining pH caused by carbon dioxide seeps is associated with declines in coral species diversity. However, in Palau carbon dioxide seeps are not associated with reduced species diversity of corals, although bioerosion of coral skeletons is much higher at low pH sites.

Other biological impacts

Aside from the slowing and/or reversing of calcification, organisms may suffer other adverse effects, either indirectly through negative impacts on food resources, or directly as reproductive or physiological effects. For example, the elevated oceanic levels of CO_2may produce CO_2-induced acidification of body fluids, known as hypercapnia. Also, increasing ocean acidity is believed to have a range of direct consequences. For example, increasing acidity has been observed

to: reduce metabolic rates in jumbo squid; depress the immune responses of blue mussels; and make it harder for juvenile clownfish to tell apart the smells of non-predators and predators, or hear the sounds of their predators. This is possibly because ocean acidification may alter the acousticproperties of seawater, allowing sound to propagate further, and increasing ocean noise. This impacts all animals that use sound for echolocation or communication. Atlantic longfin squid eggs took longer to hatch in acidified water, and the squid's statolith was smaller and malformed in animals placed in sea water with a lower pH. The lower PH was simulated with 20-30 times the normal amount of CO_2. However, as with calcification, as yet there is not a full understanding of these processes in marine organisms or ecosystems.

Another possible effect would be an increase in red tide events, which could contribute to the accumulation of toxins (domoic acid, brevetoxin, saxitoxin) in small organisms such as anchovies and shellfish, in turn increasing occurrences of amnesic shellfish poisoning, neurotoxic shellfish poisoning and paralytic shellfish poisoning.

Answer the questions:

1. What is the index of ocean acidification?
2. What will the ongoing acidification bring to?
3. What new factors about acidification have you learnt?
4. Discuss the problems of impacts on oceanic calcifying organisms and biological impacts.
5. Give the summary of Text B in your own words.

Text C

Ecosystem impacts amplified by ocean warming and deoxygenation

While the full implications of elevated CO_2 on marine ecosystems are still being documented, there is a substantial body of research showing that a combination of ocean acidification and elevated ocean temperature, driven mainly by CO_2 and other greenhouse gas emissions, have a compounded effect on marine life and the ocean environment. This effect far exceeds the individual harmful impact of either. In addition, ocean warming exacerbates ocean deoxygenation, which is an additional stressor on marine organisms, by increasing ocean stratification, through density and solubility effects, thus limiting nutrients, while at the same time increasing metabolic demand.

Meta analyses have quantified the direction and magnitude of the harmful effects of ocean acidification, warming and deoxygenation on the ocean. These meta-analyses have been further tested by mesocosm studies that simulated the interaction of these stressors and found a catastrophic effect on the marine food

web, i.e. that the increases in consumption from thermal stress more than negates any primary producer to herbivore increase from elevated CO_2.

Nonbiological impacts

Leaving aside direct biological effects, it is expected that ocean acidification in the future will lead to a significant decrease in the burial of carbonate sediments for several centuries, and even the dissolution of existing carbonate sediments. This will cause an elevation of ocean alkalinity, leading to the enhancement of the ocean as a reservoir for CO_2 with implications for climate change as more CO_2 leaves the atmosphere for the ocean.

Impact on human industry

The threat of acidification includes a decline in commercial fisheries and in the Arctic tourism industry and economy. Commercial fisheries are threatened because acidification harms calcifying organisms which form the base of the Arctic food webs.

Pteropods and brittle stars both form the base of the Arctic food webs and are both seriously damaged from acidification. Pteropods shells dissolve with increasing acidification and the brittle stars lose muscle mass when re-growing appendages. For pteropods to create shells they require aragonite which is produced through carbonate ions and dissolved calcium. Pteropods are severely affected because increasing acidification levels have steadily decreased the amount of water supersaturated with carbonate which is needed for aragonite creation. Arctic waters are changing so rapidly that they will become undersaturated with aragonite as early as 2016. Additionally the brittle star's eggs die within a few days when exposed to expected conditions resulting from Arctic acidification. Acidification threatens to destroy Arctic food webs from the base up. Arctic food webs are considered simple, meaning there are few steps in the food chain from small organisms to larger predators. For example, pteropods are "a key prey item of a number of higher predators – larger plankton, fish, seabirds, whales". Both pteropods and sea stars serve as a substantial food source and their removal from the simple food web would pose a serious threat to the whole ecosystem. The effects on the calcifying organisms at the base of the food webs could potentially destroy fisheries. The value of fish caught from US commercial fisheries in 2007 was valued at $3.8 billion and of that 73% was derived from calcifiers and their direct predators. Other organisms are directly harmed as a result of acidification. For example, decrease in the growth of marine calcifiers such as the American lobster, ocean quahog, and scallops means there is less shellfish meat available for sale and consumption. Red king crab fisheries are also at a serious threat because crabs are calcifiers and rely on carbonate ions for shell development. Baby red king crab when exposed to increased acidification levels experienced 100% mortality after 95 days. In 2006, red king crab accounted for 23% of the total guideline harvest levels and a serious decline in red crab population would threaten the crab harvesting industry. Several ocean goods and services are likely to be undermined by future ocean acidification potentially

affecting the livelihoods of some 400 to 800 million people depending upon the emission scenario.

Impact on indigenous peoples

Acidification could damage the Arctic tourism economy and affect the way of life of indigenous peoples. A major pillar of Arctic tourism is the sport fishing and hunting industry. The sport fishing industry is threatened by collapsing food webs which provide food for the prized fish. A decline in tourism lowers revenue input in the area, and threatens the economies that are increasingly dependent on tourism. The rapid decrease or disappearance of marine life could also affect the diet of Indigenous peoples.

Ocean Acidification in the Arctic Ocean

The Arctic Ocean has experienced drastic change over the years due to global warming. It has been known that the Arctic Ocean acidity levels have been increasing and at twice the rate compared to the Pacific and Atlantic oceans. The loss of sea ice has been connected to a decrease in pH levels in the ocean water. Sea ice has experienced an extreme reduction over the past 30 years, forming a minimum area of 2.9×106 km^2 at the end of the boreal summer of 2007, 47%, less than in 1980. Sea ice limits the air-sea gas exchange with carbon dioxide. With less water completely exposed to the atmosphere, the levels of carbon dioxide gas in the water remain low. The Arctic Ocean should have low carbon dioxide levels due to intense cooling, run off of fresh water and photosynthesis from marine organisms. However, the decrease of sea ice over the years due to global warming has limited freshwater runoff and has exposed a higher percentage of the ocean surface to the atmosphere. The increase of carbon dioxide in the water decreases the pH of the ocean causing ocean acidification. The decrease in sea ice has also allowed more Pacific water to flow into in the Arctic Ocean during the winter, this is called Pacific winter water. The Pacific water flows into the Arctic Ocean carrying additional amounts of carbon dioxide by being exposed to the atmosphere and absorbing carbon dioxide from decaying organic matter and from sediments.

The Arctic Ocean pH levels are rapidly decreasing because not only is the ocean water absorbing more carbon dioxide due to increased surface area exposure as a result of a decrease in sea ice. It also has large amounts of carbon dioxide being transferred to the Arctic from the Pacific ocean.

Cold water is able to absorb higher amounts of carbon dioxide compared to warm water. The solubility of gases decreases in relation to increasing temperature. Cold water bodies are absorbing the increasing amount of carbon dioxide in the atmosphere and becoming known as carbon sinks. The increasing amount of carbon dioxide in the water is putting many organisms at risk as they are affected by the increase of acidity in the ocean water.

Effects of Ocean Acidification on Arctic Organisms

Organisms in Arctic waters are already challenged with stressors of living in the Arctic Ocean, such as dealing with cold temperatures, and it is thought that because of this, additional stressors such as ocean acidification, will cause ocean

acidification effects on marine organisms to appear first in the Arctic. There exists a significant variation in the sensitivity of marine organisms to increased ocean acidification. Calcifying organisms generally exhibit larger negative responses from ocean acidification than non-calcifying organisms across numerous response variables, with the exception of crustaceans, which calcify but were not negatively affected. The acidification of the Arctic Ocean will impact these marine calcifiers in several different ways.

The uptake of CO_2 by seawater increases the concentration of hydrogen ions, which lowers pH and, in changing the chemical equilibrium of the inorganic carbon system, reduces the concentration of carbonate ions (CO_3^{2-}). Carbonate ions are required by marine calcifying organisms such as plankton, shellfish, and fish to produce calcium carbonate ($CaCO_3$) shells and skeletons.

For either aragonite or calcite, the two polymorphs of $CaCO_3$ produced by marine organisms, the saturation state of $CaCO_3$ in ocean water is expressed by the product of the concentrations of CO_2^{2-} and Ca^{2+} in seawater relative to the stoichiometric solubility product at a given temperature, salinity, and pressure. Waters which are saturated in $CaCO_3$ are favourable to precipitation and formation of $CaCO_3$ shells and skeletons, but waters which are undersaturated are corrosive to $CaCO_3$ shells, and in the absence of protective mechanisms, dissolution of calcium carbonate will occur. Because colder arctic water absorbs more CO_2, the concentration of CO_3^{2-} is reduced, therefore the saturation of calcium carbonate is lower in high-latitude oceans than it is in tropical or temperate oceans. In model simulations of the Arctic Ocean, it is predicted that aragonite saturation will decrease, because of an increased amount of freshwater input from melting sea ice and increased carbon uptake as a result of sea ice retreat. This simulation predicts that Arctic surface waters will become under saturated with aragonite within a decade. The under saturation of aragonite will cause the shells of organisms which are constructed from aragonite to dissolve. This would have a profound effect on a large variety of marine organisms and has the potential to do devastating damage to keystone species and to the marine food web in the Arctic Ocean. Laboratory experiments on various marine biota in an elevated CO_2 environment show that changes in aragonite saturation cause substantial changes in overall calcification rates for many species of marine organisms, including coccolithophore, foraminifera, pteropods, mussels, and clams.

Although the under saturation of arctic water has been proven to have an effect on the ability of organisms to precipitate their shells, recent studies have shown that the calcification rate of calcifiers, such as corals, coccolithophores, foraminifera's and bivalves, decrease with increasing pCO_2, even in seawater supersaturated with respect to $CaCO_3$. Additionally, increased pCO_2 has been found to have complex effects on the physiology, growth and reproductive success of various marine calcifiers. CO_2 tolerance seems to differ between various marine organisms, as well as differences in CO_2 tolerance at different life cycle stages (e.g. larva and adult). The first stage in the life cycle of marine calcifiers which are at a serious risk by high CO2 content is the planktonic larval stage. The larval

development of several marine species, primarily sea urchins and bivalves, are highly affected by elevations of seawater pCO_2. In laboratory tests, numerous sea urchin embryos were reared under different CO_2 concentrations until they developed to the larval stage. It was found that once reaching this stage, larval and arm sizes were significantly smaller, as well as abnormal skeleton morphology was noted with increasing pCO_2.

Similar findings have been found in CO_2 treated-mussel larvae, which showed a larval size decrease of about 20% and showed morphological abnormalities such as convex hinges, weaker and thinner shells and protrusion of mantle. The larval body size also impacts the encounter and clearance rates of food particles, and if larval shells are smaller or deformed, these larvae are more prone to starvation. In addition, $CaCO_3$ structures also serve vital functions for calcified larvae, such as defence against predation, as well as roles in feeding, buoyancy control and pH regulation. Another example of a species which may be seriously impacted by ocean acidification is Pteropods, which are shelled pelagic molluscs which play an important role in the food-web of various ecosystems. Since they harbour an aragonitic shell, they could be very sensitive to ocean acidification driven by the increase of anthropogenic CO_2 emissions.Laboratory tests showed that calcification exhibits a 28% decrease at the pH value of the Arctic Ocean expected for the year 2100, compared to the present pH value. This 28% decline of calcification in the lower pH condition is within the range reported also for other calcifying organisms such as corals. In contrast with sea urchin and bivalve larvae, corals and marine shrimps are more severely impacted by ocean acidification after settlement, while they developed into the polyp stage. From laboratory tests, the morphology of the CO_2-treated polyp endoskeleton of corals was disturbed and malformed compared to the radial pattern of control polyps.

This variability in the impact of ocean acidification on different life cycle stages of different organisms can be partially explained by the fact that most echinoderms and mollusks start shell and skeleton synthesis at their larval stage, whereas corals start at the settlement stage. Hence, these stages are highly susceptible to the potential effects of ocean acidification. Most calcifiers, such as corals, echinoderms, bivalves and crustaceans, play important roles in coastal ecosystems as keystone species, bioturbators and ecosystem engineers. The food web in the Arctic Ocean is somewhat truncated, meaning it is short and simple. Any impacts to key species in the food web can cause exponentially devastating effects on the rest on the food chain as a whole, as they will no longer have a reliable food source. If these larger organisms no longer have any source of nutrients, they too will eventually die off, and the entire Arctic Ocean ecosystem will be affected. This would have a huge impact on the Arctic people who catch Arctic fish for a living, as well as the economic repercussions which would follow such a major shortage of food and living income for these families.

I. Answer the questions:

1. What impacts on ecosystem and on human industry exist?
2. What is one of the reasons of ice sea melting?
3. What are the effects of ocean acidification on Arctic organisms?
4. Make up the plan of Text C and retell it according to it.

II. Translate the proverbs and sayings . Give your own situations with them:

1. The call of the wind
2. To get (take) wind
3. To hang in wind
4. In the wind's eye
5. Off the wind
6. To speak to the wind
7. What good wind brings you here?

GRAMMAR

The Participle

Форми дієприкметника		
	Active	**Passive**
Present **Past** **Perfect**	**asking** **—** **having asked**	**being asked** **asked** **having been asked**
Англійський дієприкметник (The Participle)*відповідає українському дієприкметнику і дієприслівнику.* ***Resting*** *— відпочиваючи; відпочиваючий.*		

Ex. 1 Перекладіть українською мовою, звертаючи увагу на дієприкметник *(Present Participle Active).*

1. The girl standing at the window is my sister.
2. We looked at the playing children.
3. Entering the room he dropped his keys.
4. He set in the arm-chair thinking.
5. She came up to us breathing heavily.
6. The hall was full of laughing people.
7. The boy smiled showing his teeth.
8. The singing girl was about fourteen.

9. Mother put eggs into the boiling water.
10. Writing letters is a waste of time.

Ex. 2 Замініть підрядні речення дієприкметниковими зворотами у *Present Participle Active.*

1. The woman called the boy **who was working** in the garden.
2. **As the wind was blowing**, it was very cold.
3. **Since I needed a pen**, I asked my friend to give me it,
4. **As he was afraid of the dog**, the boy ran quickly across the yard.
5. **Since the lessons were over**, the pupils went home, i
6. We decided to go to the cafe **as we had plenty of time**.
7. Tom can translate this article **as he knows English well**.
8. **As we thought they were waiting for us**, we were in a hurry.

Ex. 3 Замініть підрядні речення дієприкметниковими зворотами з *Present Participle Active.*

1. **When she came home**, she turned on the light.
2. **When you read English text**, copy out the new words.
3. **While he was waiting for me**, he became the witness of an accident.
4. **When I was walking through** the park, I saw some flowers.
5. **When you are leaving the house**, don't forget to lock the door.
6. He didn't write the truth **when he was writing a letter**.
7. **When she saw them**, she smiled with pleasure.
8. **When he begins to work,** he will not forget our in structions.

Ex. 4 Перекладіть українською мовою, звертаючи увагу на дієприкметник *(Present Participle Passive).*

1. The question being discussed now is very important.
2. He doesn't know the song being heard.
3. The house being built in our street is a new supermarket.
4. Do you like the film being discussed?
5. Being asked at the lesson, the boy answered nothing.
6. The experiment being carried on by this scientist is very important.
7. Being packed in the beautiful box the flowers looked very lovely.

Ex. 5 Перекладіть українською мовою, звертаючи увагу на *Participle I* та *Participle II*.

1. A person taking a bath is our patient.
2. A person taking to the hospital was his brother.
3. The letter written by him was very long.
4. Don't make mistakes writing a letter.
5. The question put to the professor were important.
6. While putting the flowers into the vase he broke it.
7. I saw my friend saying good bye to his girl-friend.
8. She didn't understand the word said by him.
9. He didn't see the things kept in her box.
10. Ann entered the room keeping a book in her hand.

Порівняйте вживання

Participle I *("ing" — форма) та*
Participle II *(III форма дієслова)*

writing - *пишучи*	**written** - *написаний*
discussing — *обговорюючи*	**discussed** — *обговорений*

Ex. 6 Доберіть необхідну форму дієприкметника.

1. Who is the girl (doing, done) her task on the blackboard?
2. The book (writing, written) by him is not very interesting.
3. The translation (doing, done) by me was very easy.
4. The (loosing, lost) keys were not found.
5. The (loosing, lost) team will not get the prize.
6. I don't like the video (buying, bought) yesterday.
7. Do you know the boy (coming, come) towards us?
8. We like the songs (singing, sung) by this singer.
9. The woman (singing, sung) is his wife.

10. The question (discussing, discussed) at the meeting was very important.

Ex. 7 Розкрийте дужки, вживаючи *Present Participle* чи *Perfect Participle.*

1. (to write) out all the new words, I started to learn them.
2. (to live) in Kyiv, he was able to see all the ancient monuments.
3. (to hear) my friend's voice, I left the room to open the door.
4. We went home, (to look) through the documents.
5. (to drink) coffee she was talking to her friend.
6. (to go) down the street, the boy was looking back from time to time.
7. (to throw) the ball, the little girl ran home.
8. I think that the man (to stand) there is her father.
9. (to buy) food, they left supermarket.
10. (to know) French well the pupil can translate this text.
11. She entered the room (to smile).
12. (to see) the stranger the dog began barking.
13. (to bark) dog doesn't bite.
14. (to find) the keys, we were able to open the door.

Переклад різних форм дієприкметників українською мовою:	
Форма дієприкметника	Переклад
discussing	*що обговорюється, обговорюючи*
having discussed	*обговоривши*
being discussed	*який обговорюють, який обговорили*
having been discussed	*який обговорили, будучи обговореним*
discussed	*обговорений*
building	*який будується, будуючи*
having built	*побудувавши {*
hoing built	*який будується, який будувався*
having been built	*який побудували, будучи побудованим*
built	*побудований*
Переклад різних форм дієприкметників англійською мовою:	
кидаючий	throwing
що кидають	throwing ;
який кидають (в даний момент)	being thrown
який кидають (регулярно)	thrown
кинутий	throwing

кидаючи	throwing
кинувши (причина)	having thrown
кинувши (супутні обставини)	throwing
кинувши (до іншої дії)	being thrown
який кинули	being thrown having been thrown

Ex. 8 Розкрийте дужки, вживаючи необхідну форму дієприкметника.

1. He walked down the road (to sing).
2. (to enter) the room I recognized him at once.
3. (to put) on the coat, she ran out of the house.
4. The man (to teach) math at their school studied in Odessa.
5. (to translate) into a foreign language the story lost all its charm.
6. (to come) home she found nobody there.
7. He woke up (to think) of his parents.
8. (to be) a woman of taste she always dresses well.
9. There are some people (to come) in now.
10. (to translate) seven articles, he decided to have a break.
11. You make mistake (to judge) people by their appearance.
12. (to be) very tired, she soon fell asleep.
13. The boy went in, (to carry) his case.
14. While (to discuss) this problem, we sat on the window sill.

Ex. 9 Перекладіть українською мовою, звертаючи увагу на герундій.

1. Taking medicine is unpleasant thing.
2. He sat without answering.
3. Smoking is forbidden here.
4. He is fond of painting.
5. My shoes need repairing.
6. They went on talking.
7. It looks like raining.
8. The band began playing music.
9. She has a habit of interrupting people.
10. I like learning foreign languages.
11. They continue their studying.
12. My parents insist on my staying there.
13. Thank you for helping.
14. My friend can't help speaking about this event.
15. After coming home the boy had dinner.
16. We enjoyed playing tennis.
17. Her child is afraid of swimming.
18. They were informed of our arriving.

19.She is incapable of doing it.
20.:He is suspected of stealing money.

Ex. 10 Утворіть герундій, перекладіть речення українською мовою.

1. She does a lot of (read).
2. What he likes is (drive).
3. No (park) here.
4. We heard a lot of (shout) last night.
5. Quick (run) saved him.
6. I am not against his (come).
7. Who does (wash) in your house?
8. We did some (shop) this morning.
9. She hates (do) the washing-up.
10. (act) is an interesting profession.
11. No (camp).
12. There's no (regret) my decision.
13. Their (shout) woke people up.
14. We don't mind (invite) him.
15. Excuse me, I (be) late.
16. Try it on before (complain).
17. My friend enjoys a bit of (sing).
18. (be) late is a shame.
19. I like his (guitar play).
20. This is used for (cut) meat.
21. No (smoke) here.
22. These (draw) are expensive.
23. She has done very little (iron) today.
24. Do you like (cycle)?
25. Yesterday he had some (train).
26. (not be) late is a good habit.
27. There was (ring) of a bell.
28. Does she like (make) plans?
29. No (fish) here.
30. I don't like (watch) football

The Gerund

Форми герундія		
	Active	**Passive**
Indefinite	writing	being written
Perfect	having written	having been written

Ex. 11 Перекладіть українською мовою, звертаючи увагу на переклад різних форм герундія.

1. I can’t remember having seen him before.
2. This film is worth seeing.
3. We can’t excuse their not answering our invitation.
4. I am sorry for having disturbed you.
5. She entered the office without being noticed.
6. He doesn’t like having been invited to their parties.
7. She is angry at having been sent for.
8. Everybody enjoy working with him.
9. We are proud of having been her pupils.
10. You should avoid breaking rules.
11. The boy hates being scolded.
12. The child is proud of having been praised by his parents.

Запам’ятайте слова та вирази, після яких ставиться герундій		
to avoid	to fancy	to postpone
to admit	to finish	to put off
to appreciate	to forgive	to stop
to consider	to imagine	to give up
to delay	to help (on)	to go on
to deny	to mention	to suggest
to detect	to mind	to resent
to enjoy	to miss	
to explain	to pardon	

Ex. 12 Перекладіть англійською мовою, використовуючи герундій.

1. Він покинув палити.
2. Я не заперечую проти того, щоб поїхати туди.
3. Вона перестала прикидатися здорового.
4. Він ненавидить, коли йому брешуть.
5. Тобі подобається кататися на ковзанах?
6. Нарешті дитина перестала плакати.
7. Нам запропонували поїхати до моря.
8. Вона уникала говорити про це з матір’ю.
9. Я згадав, що мене теж запросили туди.
10. Припини тремтіти.
11. Уяви собі поїздку туди.
12. Будь ласка, припини думати тільки про свої проблеми.
13. Дівчина заперечувала, що була вдома тоді.
14. Він продовжував працювати.
15. Я дуже ціную вашу допомогу.

Запам'ятайте дієслова та вирази, після яких ставиться герундій з певними прикметниками:		
to agree to to accuse of to approve of to be afraid of to consist in to complain of to prevent from to succeed in	to persist in to be engaged in to spend in to result in to hear of to suspect of to inform of to give up the idea of	to think of to be capable of to be fond of to be proud of to insist on to depend on to object to to be surprised at

Ex. 13 Перекладіть англійською мовою, використовуючи герундій.

1. Його звинувачують в пограбуванні.
2. Я хочу проінформувати вас про їхній приїзд.
3. Вона часто проводить час читаючи журнали.
4. Я здивований, що мене спитали про це.
5. Вони не здатні брехати.
6. Батьки наполягають на тому, щоб я відвідав лікаря.
7. Ми займаємось розвитком цього проекту.
8. Юнак думав про те, щоб залишити рідне місто.
9. Жінка наполегливо продивлялась папери, шукаючи необхідного документа.
10. Літній чоловік боявся бути прооперованим.
11. Батько взяв дитину за руку, щоб не дати їй впасти.
12. Не звинувачуй її в тому, що вона зробила таку серйозну помилку.
13. Ми наполягатимемо на тому, щоб нам розповіли все.

Ex. 14 Перекладіть англійською мовою, використовуючі герундій.

1. Чому він уникає розмов з тобою?
2. Ти не думаєш, що квіти необхідно полити?
3. Хворого необхідно відправити до лікарні.
4. Мій друг думає, що не варто купувати цього відеофільму,
5. Варто послухати, як вона співає.
6. Моя бабуся любить розповідати казки, а мій син слухати їх.
7. Чи варто йти на цю дискотеку?
8. Подивись на свій костюм! Його треба почистити.
9. Цей пейзаж вартий того, щоб його намалювати.
10. Іван не любить, коли його сварять.
11. Мій комп'ютер треба відремонтувати.
12. Вони думають про те, як би затримати наш приїзд.

Запам'ятайте дієслова і вирази? після яких ставиться герундій	
to feel like	can't help

to be for to be against	can't avoid can't afford
She couldn't help crying. We don't feel like walking.	*Вона не могла не плакати.* *Нам не хочеться йти пішки.*

Ex. 15 Перекладіть англійською мовою, використовуючи герундій.

1. Ви не проти того, щоб вас представили їм?
2. Килим в твоїй кімнаті необхідно почистити.
3. Молода жінка не могла не засміятись.
4. Батько був за те, щоб купити нову машину.
5. Ти хочеш піти в кіно?
6. Хто за те, щоб поїхати до моря?Нона не може дозволити собі купувати такі дорогі речі.
7. Я не хочу думати про це. її Нони не могли не розказати їй про свою радість.
8. Чому ти уникаєш того, щоб тебе запитали про це?
9. Він не міг не спробувати пояснити, як це робиться.
10. Я не можу дозволити собі витрачати так багато часу даремно.

Ex. 16 Перекладіть англійською мовою, використовуючи герундій.

1. Я не міг не посміхнутись, дивлячись як бавляться кошенята.
2. Хлопчик розлютився через те, що над ним сміялися.
3. Батьки були не проти того, щоб купити мені новий комп'ютер.
4. Я увійшов до кімнати з наміром розказати про своє рішення.
5. Не втрачай нагоди подивитися цю виставку.
6. Я пишаюсь тим, що був у змозі допомогти вам.
7. Всі боялися, що він довідається про правду.
8. Хто має щось проти того, щоб випити пива?
9. Подивись на ці меблі. їх треба відремонтувати.
10. Вона не хотіла йти за покупками.
11. Я за те, щоб летіти туди літаком.
12. Ми хочемо знати причини вашого від'їзду.
13. Професор не був проти проведення нових дослідів.
14. Почувши таку сумну історію, вона не могла не заплакати.
15. Я не хочу відповідати на безглузді запитання.

Ex. 17 Перекладіть англійською мовою, використовуючи герундій.

1. Після закінчення школи він вступив до університету.
2. Всі чекали, що він працюватиме із задоволенням.
3. Він був здивований її раптовою смертю.
4. Директор наполягав на тому, щоб роботу дали мені.
5. Дуже важко жити без віри.
6. Вона уникала обідати вдома.
7. Він здивований, що з ним поговорили про це.

8. Я вважаю, що робота цієї людини варта загального визнання.
9. Вона має звичку весь час запитувати мене про моє ставлення до цієї чи іншої проблеми.
10. Ти повинен добре продивитись статтю перед її опублікуванням.
11. Він заперечує проти того, щоб корабель залишив порт в такий шторм.
12. Ця людина не варта твоїх сліз.
13. Крім того, що вона красива, вона ще й розумна.
14. Людина лежала не дихаючи.
15. Його вчинок вартий схвалення.
16. Головне — потрапити на вокзал вчасно.

Ex. 18 Розкрийте дужки, використовуючи герундій.

The art of (cook) requires (use) of garlic.
The (eat) of garlic is not approved of.
(Work) beside someone who has eaten garlic is as bad as (sit) beside someone who smokes. But while (smoke) is bad for you, there is no doubt that (eat) garlic is good for the health.
We can see more 'No (smoke)' signs, but we can't see 'No (breath)' signs for garlic eaters. (Cultivate) and (export) garlic is a big business. Many people use it for (flavour) and (add) to different dishes. Some people buy it when they do (shop). You can't deny (use) or (eat) it. (Be) a garlic eater is something to be proud of. It shows you enjoy good (live).

Ex. 19 Перекладіть англійською мовою, використовуючи герундій.
1. Марно розмовляти з нею зараз.
2. Чи варто робити це?
3. Заперечувати йому не мало жодного сенсу.
4. Коли він в такому настрої, розмовляти з ним нерозумно.
5. Не було сенсу приходити сюди так рано.
6. Сльози тобі не допоможуть.
7. Марно приховувати ці факти.
8. Думати про це зараз не має сенсу.
9. Не має сенсу шукати дорогу в темряві.
10. Розмовами справі не зарадиш.

LESSON 4

HYDROLOGY

INTRODUCTION

Hydrology is the scientific study of the movement, distribution, and quality of water on Earth and other planets, including the water cycle, water resources and environmental watershed sustainability. A practitioner of hydrology is a **hydrologist**, working within the fields of earth or environmental science, physical geography, geology or civil and environmental engineering. Using various analytical methods and scientific techniques, they collect and analyze data to help solve water related problems such as environmental preservation, natural disasters, and water management.

Hydrology subdivides into surface water hydrology, groundwater hydrology (hydrogeology), and marine hydrology. Domains of hydrology include hydrometeorology, surface hydrology, hydrogeology, drainage-basin management and water quality, where water plays the central role.

Oceanography and meteorology are not included because water is only one of many important aspects within those fields.

Hydrological research can inform environmental engineering, policy and planning.

History

Hydrology has been a subject of investigation and engineering for millennia. For example, about 4000 BC the Nile was dammed to improve agricultural productivity of previously barren lands. Mesopotamian towns were protected from flooding with high earthen walls. Aqueducts were built by the Greeks and Ancient Romans, while the history of China shows they built irrigation and flood control works. The ancient Sinhalese used hydrology to build complex irrigation works in Sri Lanka, also known for invention of the Valve Pit which allowed construction of large reservoirs, anicuts and canals which still function.

Marcus Vitruvius, in the first century BC, described a philosophical theory of the hydrologic cycle, in which precipitation falling in the mountains infiltrated the Earth's surface and led to streams and springs in the lowlands. With adoption of a more scientific approach, Leonardo da Vinci and Bernard Palissy independently reached an accurate representation of the hydrologic cycle. It was not until the 17th century that hydrologic variables began to be quantified.

Pioneers of the modern science of hydrology include Pierre Perrault, Edme Mariotte and Edmund Halley. By measuring rainfall, runoff, and drainage area, Perrault showed that rainfall was sufficient to account for flow of the Seine. Marriotte combined velocity and river cross-section measurements to obtain discharge, again in the Seine. Halley showed that the evaporation from the Mediterranean Seawas sufficient to account for the outflow of rivers flowing into the sea.

Advances in the 18th century included the Bernoulli piezometer and Bernoulli's equation, by Daniel Bernoulli, and the Pitot tube, by Henri Pitot. The 19th century saw development in groundwater hydrology, including Darcy's law, the Dupuit-Thiem well formula, and Hagen-Poiseuille's capillary flow equation.

Rational analyses began to replace empiricism in the 20th century, while governmental agencies began their own hydrological research programs. Of particular importance were Leroy Sherman's unit hydrograph, the infiltration theory of Robert E. Horton, and C.V. Theis's aquifer test/equation describing well hydraulics.

Since the 1950s, hydrology has been approached with a more theoretical basis than in the past, facilitated by advances in the physical understanding of hydrological processes and by the advent of computers and especially geographic information systems.

Themes

The central theme of hydrology is that water circulates throughout the Earth through different pathways and at different rates. The most vivid image of this is in the evaporation of water from the ocean, which forms clouds. These clouds drift over the land and produce rain. The rainwater flows into lakes, rivers, or aquifers. The water in lakes, rivers, and aquifers then either evaporates back to the atmosphere or eventually flows back to the ocean, completing a cycle. Water changes its state of being several times throughout this cycle.

The areas of research within hydrology concern the movement of water between its various states, or within a given state, or simply quantifying the amounts in these states in a given region. Parts of hydrology concern developing methods for directly measuring these flows or amounts of water, while others concern modelling these processes either for scientific knowledge or for making prediction in practical applications.

Text A

1. Groundwater

Ground water is water beneath Earth's surface, often pumped for drinking water. Groundwater hydrology (hydrogeology) considers quantifying groundwater flow and solute transport. Problems in describing the saturated zone include the characterization of aquifers in terms of flow direction, groundwater pressure and, by inference, groundwater depth (see: aquifer test). Measurements here can be made using a piezometer. Aquifers are also described in terms of hydraulic conductivity, storativity and transmissivity. There are a number of geophysical methods for characterising aquifers. There are also problems in characterising the vadose zone (unsaturated zone).

2. Infiltration

Infiltration is the process by which water enters the soil. Some of the water is absorbed, and the rest percolates down to the water table. The infiltration capacity, the maximum rate at which the soil can absorb water, depends on several factors. The layer that is already saturated provides a resistance that is proportional to its thickness, while that plus the depth of water above the soil provides the driving force (hydraulic head). Dry soil can allow rapid infiltration by capillary

action; this force diminishes as the soil becomes wet. Compaction reduces the porosity and the pore sizes. Surface cover increases capacity by retarding runoff, reducing compaction and other processes. Higher temperatures reduce viscosity, increasing infiltration.

3. Surface water flow

Hydrology considers quantifying surface water flow and solute transport, although the treatment of flows in large rivers is sometimes considered as a distinct topic of hydraulics or hydrodynamics. Surface water flow can include flow both in recognizable river channels and otherwise. Methods for measuring flow once water has reached a river include the stream gauge, and tracer techniques. Other topics include chemical transport as part of surface water, sediment transport and erosion.

One of the important areas of hydrology is the interchange between rivers and aquifers. Groundwater/surface water interactions in streams and aquifers can be complex and the direction of net water flux (into surface water or into the aquifer) may vary spatially along a stream channel and over time at any particular location, depending on the relationship between stream stage and groundwater levels.

4. Precipitation types

Dynamic or adiabatic cooling is the primary cause of condensation and is responsible for most rainfall. Thus it can be seen that vertical transport of air masses is a requirement for precipitation. Precipitation may be classified according to the conditions which generate vertical air motion. In this respect, the three major categories of precipitation type are conventional, orographic, and cyclonic.

Convective Precipitation. Convectional precipitation is typical of the tropics and is brought about by heating of the air at the interface with the ground. This heated air expands with a resultant reduction in weight. During this period, increasing quantities of water vapour are taken up, the warm moisture-laden air becomes unstable, and pronounced vertical currents are developed. Dynamic cooling takes place, causing condensation and precipitation. Convective precipitation may be in the form of light showers or storms of extremely high intensity.

Orographic Precipitation. Orographic precipitation results from the mechanical lifting of moist horizontal air currents over natural barriers such as mountain ranges.

Cyclonic Precipitation. Cyclonic precipitation is associated with movements of air masses from high-pressure regions to low-pressure regions. These pressure differences are created by the unequal heating of the earth's surface.

Cyclonic precipitation may be classified as frontal or nonfrontal. Any barometric low can produce nonfrontal precipitation as air is lifted through horizontal convergence of the inflow into a low pressure area. Frontal precipitation results from the lifting of warm air over cold air at the contact zone between air masses having different characteristics. If the air masses are moving so that warm air replaces colder air, the front is known as a warm front; if, on the other hand, cold air displaces warm air, the front is said to be cold. If the front is not in motion, it is said to be a stationary front.

5. Standards

In the setting of standards, agencies make political and technical/scientific decisions about how the water will be used. In the case of natural water bodies, they also make some reasonable estimate of pristine conditions. Natural water bodies will vary in response to environmental conditions. Environmental scientists work to understand how these systems function, which in turn helps to identify the sources and fates of contaminants. Environmental lawyers and policymakers work to define legislation with the intention that water is maintained at an appropriate quality for its identified use.

The vast majority of surface water on the Earth is neither potable nor toxic. This remains true when seawater in the oceans (which is too salty to drink) is not counted. Another general perception of water quality is that of a simple property that tells whether water is polluted or not. In fact, water quality is a complex subject, in part because water is a complex medium intrinsically tied to the ecology of the Earth. Industrial and commercial activities (e.g. manufacturing, mining, construction, transport) are a major cause of water pollutionas are runoff from agricultural areas, urban runoff and discharge of treated and untreated sewage.

6. Water cycle

The **water cycle**, also known as the **hydrological cycle** or the **hydrologic cycle**, describes the continuous movement of water on, above and below the surface of the Earth. The mass of water on Earth remains fairly constant over time but the partitioning of the water into the major reservoirs of ice, fresh water, saline water and atmospheric water is variable depending on a wide range of climatic variables. The water moves from one reservoir to another, such as from river to ocean, or from the ocean to the atmosphere, by the physical processes of evaporation, condensation, precipitation, infiltration, surface runoff, and subsurface flow. In doing so, the water goes through different forms: liquid, solid (ice) and vapor.

The water cycle involves the exchange of energy, which leads to temperaturechanges. When water evaporates, it takes up energy from its surroundings and cools the environment. When it condenses, it releases energy and warms the environment. These heat exchanges influence climate.

The evaporative phase of the cycle purifies water which then replenishes the land with freshwater. The flow of liquid water and ice transports minerals across the globe. It is also involved in reshaping the geological features of the Earth, through processes including erosion and sedimentation. The water cycle is also essential for the maintenance of most life and ecosystems on the planet.

Categories

The parameters for water quality are determined by the intended use. Work in the area of water quality tends to be focused on water that is treated for human consumption, industrial use, or in the environment.

7. Human consumption

Contaminants that may be in untreated water include microorganisms such as viruses, protozoa and bacteria; inorganic contaminants such as salts and metals; organic chemical contaminants from industrial processes and petroleum use; pesticides and herbicides; and radioactive contaminants. Water quality depends on the local geology and ecosystem, as well as human uses such as sewage dispersion, industrial pollution, use of water bodies as a heat sink, and overuse (which may lower the level of the water).

The United States Environmental Protection Agency (EPA) limits the amounts of certain contaminants in tap water provided by US public water systems. The Safe Drinking Water Act authorizes EPA to issue two types of standards:

- *primary standards* regulate substances that potentially affect human health;
- *secondary standards* prescribe aesthetic qualities, those that affect taste, odor, or appearance.

The U.S. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water that must provide the same protection for public health. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of these contaminants does not necessarily indicate that the water poses a health risk.

In urbanized areas around the world, water purification technology is used in municipal water systems to remove contaminants from the source water (surface water or groundwater) before it is distributed to homes, businesses, schools and other recipients. Water drawn directly from a stream, lake, or aquifer and that has no treatment will be of uncertain quality.

8. Industrial and domestic use

Dissolved minerals may affect suitability of water for a range of industrial and domestic purposes. The most familiar of these is probably the presence of ions of calcium (Ca^{2+}) and magnesium (Mg^{2+}) which interfere with the cleaning action of soap, and can form hard sulfate and soft carbonate deposits in water heaters or boilers. Hard water may be softened to remove these ions. The softening process often substitutes sodium cations. Hard water may be preferable to soft water for human consumption, since health problems have been associated with excess sodium and with calcium and magnesium deficiencies. Softening decreases nutrition and may increase cleaning effectiveness. Various industries' wastes and effluents can also pollute the water quality in receiving bodies of water.

Answer the questions:

1. Make up 20 questions of all types to parts 1-8.
2. Write the essay of Text A as to your own plan.

Text B

Environmental water quality, also called **ambient water quality,** relates to water bodies such as lakes, rivers, and oceans. Water quality standards for surface waters vary significantly due to different environmental conditions, ecosystems, and intended human uses. Toxic substances and high populations of certain microorganisms can present a health hazard for non-drinking purposes such as irrigation, swimming, fishing, rafting, boating, and industrial uses. These conditions may also affect wildlife, which use the water for drinking or as a habitat. Modern water quality laws generally specify protection of fisheries and recreational use and require, as a minimum, retention of current quality standards. There is some desire among the public to return water bodies to pristine, or pre-industrial conditions. Most current environmental laws focus on the designation of particular uses of a water body.In some countries these designations allow for some water contamination as long as the particular type of contamination is not harmful to the designated uses. Given the landscape changes (e.g., land development, urbanization, clearcutting in forested areas) in the watersheds of many freshwater bodies, returning to pristine conditions would be a significant challenge. In these cases, environmental scientists focus on achieving goals for maintaining healthy ecosystems and may concentrate on the protection of populations of endangered species and protecting human health.

Sample collection

More complex measurements are often made in a laboratory requiring a water sample to be collected, preserved, transported, and analyzed at another location. The process of water sampling introduces two significant problems:

- The first problem is the extent to which the sample may be representative of the water source of interest. Many water sources vary with time and with location. The measurement of interest may vary seasonally or from day to night or in response to some activity of man or natural populations of aquatic plants and animals. The measurement of interest may vary with distances from the water boundary with overlying atmosphere and underlying or confining soil. The sampler must determine if a single time and location meets the needs of the investigation, or if the water use of interest can be satisfactorily assessed by averagedvalues with time and location, or if critical maxima and minima require individual measurements over a range of times, locations or events. The sample collection procedure must assure correct weighting of individual sampling times and locations where averaging is appropriate. Where critical maximum or minimum values exist, statistical methods must be applied to observed variation to determine an adequate number of samples to assess probability of exceeding those critical values.
- The second problem occurs as the sample is removed from the water source and begins to establish chemical equilibrium with its new surroundings – the sample container. Sample containers must be made of materials with minimal reactivity with substances to be measured; and pre-cleaning of sample containers is important. The water sample may dissolve part of the sample

container and any residue on that container, or chemicals dissolved in the water sample may sorb onto the sample container and remain there when the water is poured out for analysis. Similar physical and chemical interactions may take place with any pumps, piping, or intermediate devices used to transfer the water sample into the sample container. Water collected from depths below the surface will normally be held at the reduced pressure of the atmosphere; so gas dissolved in the water may escape into unfilled space at the top of the container. Atmospheric gas present in that air space may also dissolve into the water sample. Other chemical reaction equilibria may change if the water sample changes temperature. Finely divided solid particles formerly suspended by water turbulence may settle to the bottom of the sample container, or a solid phase may form from biological growth or chemical precipitation. Microorganisms within the water sample may biochemically alter concentrations of oxygen, carbon dioxide, and organic compounds. Changing carbon dioxide concentrations may alter pH and change solubility of chemicals of interest. These problems are of special concern during measurement of chemicals assumed to be significant at very low concentrations.

Sample preservation may partially resolve the second problem. A common procedure is keeping samples cold to slow the rate of chemical reactions and phase change, and analyzing the sample as soon as possible; but this merely minimizes the changes rather than preventing them. A useful procedure for determining influence of sample containers during delay between sample collection and analysis involves preparation for two artificial samples in advance of the sampling event. One sample container is filled with water known from previous analysis to contain no detectable amount of the chemical of interest. This sample, called a "blank", is opened for exposure to the atmosphere when the sample of interest is collected, then resealed and transported to the laboratory with the sample for analysis to determine if sample holding procedures introduced any measurable amount of the chemical of interest. The second artificial sample is collected with the sample of interest, but then "spiked" with a measured additional amount of the chemical of interest at the time of collection. The blank and spiked samples are carried with the sample of interest and analyzed by the same methods at the same times to determine any changes indicating gains or losses during the elapsed time between collection and analysis.

Testing in response to natural disasters and other emergencies

Inevitably after events such as earthquakes and tsunamis, there is an immediate response by the aid agencies as relief operations get underway to try and restore basic infrastructure and provide the basic fundamental items that are necessary for survival and subsequent recovery. Access to clean drinking water and adequate sanitation is a priority at times like this. The threat of disease increases hugely due to the large numbers of people living close together, often in squalid conditions, and without proper sanitation.

After a natural disaster, as far as water quality testing is concerned there are widespread views on the best course of action to take and a variety of methods can

be employed. The key basic water quality parameters that need to be addressed in an emergency are bacteriological indicators of fecal contamination, free chlorine residual, pH, turbidity and possibly conductivity/total dissolved solids. There are a number of portable water test kits on the market widely used by aid and relief agencies for carrying out such testing.

After major natural disasters, a considerable length of time might pass before water quality returns to pre-disaster levels. For example, following the 2004 Indian Ocean tsunami the Colombo-based International Water Management Institute (IWMI) monitored the effects of saltwater and concluded that the wells recovered to pre-tsunami drinking water quality one and a half years after the event. IWMI developed protocols for cleaning wells contaminated by saltwater; these were subsequently officially endorsed by the World Health Organization as part of its series of Emergency Guidelines.

Chemical analysis

The simplest methods of chemical analysis are those measuring chemical elements without respect to their form. Elemental analysis for oxygen, as an example, would indicate a concentration of 890 g/L (grams per litre) of water sample because oxygen (O) has 89% mass of the water molecule (H_2O). The method selected to measure dissolved oxygen should differentiate between diatomic oxygen and oxygen combined with other elements. The comparative simplicity of elemental analysis has produced a large amount of sample data and water quality criteria for elements sometimes identified as heavy metals. Water analysis for heavy metals must consider soil particles suspended in the water sample. These suspended soil particles may contain measurable amounts of metal. Although the particles are not dissolved in the water, they may be consumed by people drinking the water. Adding acid to a water sample to prevent loss of dissolved metals onto the sample container may dissolve more metals from suspended soil particles. Filtration of soil particles from the water sample before acid addition, however, may cause loss of dissolved metals onto the filter. The complexities of differentiating similar organic molecules are even more challenging.

Making these complex measurements can be expensive. Because direct measurements of water quality can be expensive, ongoing monitoring programs are typically conducted by government agencies. However, there are local volunteer programs and resources available for some general assessment. Tools available to the general public include on-site test kits, commonly used for home fish tanks, and biological assessment procedures.

Answer the questions:

1. What does ambient water quality relate to? How often does water quality standard vary?
2. Describe the first problem of process of water sampling.
3. What is the second problem in sample collection?

4. What is a “blank” sample?
5. What can be testing in response to natural disasters?
6. Speak about chemical analyses of water samples.

Text C

Drinking water indicators

The following is a list of indicators often measured by situational category:

- Alkalinity
- Color of water
- pH
- Taste and odor (geosmin, 2-Methylisoborneol (MIB), etc.)
- Dissolved metals and salts (sodium, chloride, potassium, calcium, manganese, magnesium)
- Microorganisms such as fecal coliform bacteria (*Escherichia coli*), Cryptosporidium, and Giardia lamblia; *see* Bacteriological water analysis
- Dissolved metals and metalloids (lead, mercury, arsenic, etc.)
- Dissolved organics: colored dissolved organic matter (CDOM), dissolved organic carbon(DOC)
- Radon
- Heavy metals
- Pharmaceuticals
- Hormone analogs

Drinking water quality standards describes the quality parameters set for drinking water. Despite the truth that every human on this planet needs drinking water to survive and that water may contain many harmful constituents, there are no universally recognized and accepted international standards for drinking water. Even where standards do exist, and are applied, the permitted concentration of individual constituents may vary by as much as ten times from one set of standards to another.

Many developed countries specify standards to be applied in their own country. In Europe, this includes the European Drinking Water Directive and in the United States the United States Environmental Protection Agency (EPA) establishes standards as required by the Safe Drinking Water Act. For countries without a legislative or administrative framework for such standards, the World Health Organization publishes guidelines on the standards that should be achieved. China adopted its own drinking water standard GB3838-2002 (Type II) enacted by Ministry of Environmental Protection in 2002.

Where drinking water quality standards do exist, most are expressed as guidelines or targets rather than requirements, and very few water standards have any legal basis or, are subject to enforcement. Two exceptions are the European Drinking Water Directive and the Safe Drinking Water Act in the USA, which require legal compliance with specific standards.

In Europe, this includes a requirement for member states to enact appropriate local legislation to mandate the directive in each country. Routine inspection and, where required, enforcement is enacted by means of penalties imposed by the European Commission on non-compliant nations.

Countries with guideline values as their standards include Canada, which has guideline values for a relatively small suite of parameters, New Zealand, where there is a legislative basis, but water providers have to make "best endeavours" to comply with the standards, and Australia.

Hydrological transport model

A **hydrological transport model** is a mathematical model used to simulate river or stream flow and calculate water quality parameters. These models generally came into use in the 1960s and 1970s when demand for numerical forecasting of water quality was driven by environmental legislation, and at a similar time widespread access to significant computer power became available. Much of the original model development took place in the United States and United Kingdom, but today these models are refined and used worldwide.

There are dozens of different transport models that can be generally grouped by pollutantsaddressed, complexity of pollutant sources, whether the model is steady state or dynamic, and time period modeled. Another important designation is whether the model is distributed (i.e. capable of predicting multiple points within a river) or lumped. In a basic model, for example, only one pollutant might be addressed from a simple point discharge into the receiving waters. In the most complex of models, various line source inputs from surface runoff might be added to multiple point sources, treating a variety of chemicals plus sediment in a dynamic environment including vertical river stratification and interactions of pollutants with in-stream biota. In addition watershed groundwater may also be included. The model is termed "physically based" if its parameters can be measured in the field.

Often models have separate modules to address individual steps in the simulation process. The most common module is a subroutinefor calculation of surface runoff, allowing variation in land use type, topography, soil type, vegetative cover, precipitation and land management practice (such as the application rate of a fertilizer). The concept of hydrological modeling can be extended to other environments such as the oceans, but most commonly (and in this article) the subject of a river watershed is generally implied.

Runoff

The movement of the water over the surface of the Earth under the influence of gravity, in channels ranging from tiny streams to large rivers, is called runoff. Considering the hydro-logic cycle over a drainage basin or watershed, runoff is a residual of the hydrologic process, because it represents the excess of precipitation over evapotranspiration when allowance is made for storage on and under the ground surface. When precipitation is spasmodic and irregular in space, time and amount, runoff from the land surface is usually low and becomes a comparatively constant

factor. This contrast between runoff and precipitation, from which the former is derived, results mainly from the storage capacity of the surface layers of the Earth, by which much of the excess precipitation is held back and released only gradually into the streams. It has been estimated that one foot of soil normally holds more water than in the entire overlying atmospheric column.

The rate or discharge of runoff is usually expressed as a volume per unit of time. When the water discharge is plotted against the time, the plot is called a hydrograph. Analysis of the hydrograph can reveal much about the watershed characteristics that affect the disposal of precipitation and, consequently, the apportioning of surface and groundwater runoff. Hydrologic studies of runoff are important in various respects. The study of runoff over the land and in the channel is necessary for the development of land drainage and river-engineering works. A study of the short-term runoff patterns involves the analysis of flood hydrographs, flood frequencies, flood forecasting, and routing floods through the river channels. There are basic in flood-control engineering and flood-plan regulation. A study of the annual runoff characteristics and long-term trends of runoff involves the analysis of river regimes; basin geomorphology and theoretical probability analyses are required for the planning and development of irrigation, waterpower, water supply, and other water-resources projects. Modern engineers and planners of such projects require a thorough understanding of the quantitative as well as qualitative nature of the runoff.

Runoff represents precipitation returning to the sea or to the inland bodies of water. It is that portion of the precipitation that appears in surface streams. It consists, in ever varying proportions, of both surface runoff and ground-water runoff, or effluent seepage. There has been considerable difference in the use of terms relating to runoff, but it is suggested that the “overland runoff” be used to designate the water flowing over the land surface before it reaches a definite stream channel; the term ’’surface runoff ” to designate the water that reaches the stream as overland runoff, in contrast to the groundwater runoff; and the term “direct runoff ” to designate the surface runoff that has not been retarded by storage on the surface as snow or ice or in a lake or other body of standing water.

Runoff from the land area of the earth represents the excess of evaporation from the ocean area over precipitation upon that area. Unless the two are equal, water vapour is continually escaping from the outer atmosphere and the ocean level is progressively lowering. Temporarily excess evaporation from the ocean may be store on the land as snow and ice and as ground and surface storage. It cannot be stored in the atmosphere, because the air can seldom hold more than 2 to 3 days’ evaporation from a water surface in a given locality. Water evaporated from the ocean is in part precipitated on the ocean and in part carried inland by air currents, to be precipitated on the land. Of the moisture precipitated on the land area: a) some is evaporated and carried back over the ocean area by the winds to be reprecipitated or to be returned to the land area; b) some returns to the sea as surface runoff; c) some seeps into the ground to reappear in streams as ground-water runoff; d) some is evaporated from the ground surface and the surface of vegetation; e) some is temporarily stored in the soil to be reevaporated and reprecipitated; f) some is absorbed by the roots of

growing plants and transpired into the atmosphere to be reprecipitated; g) some enters into the plant fiber to remain until the plant is desiccated or destroyed.

Surface runoff modelling

A key component of a hydrological transport model is the surface runoff element, which allows assessment of sediment, fertilizer, pesticide and other chemical contaminants. Building on the work of Horton, the unit hydrograph theory was developed by Dooge in 1959. It required the presence of the National Environmental Policy Act and kindred other national legislation to provide the impetus to integrate water chemistry to hydrology model protocols. In the early 1970s the U.S. Environmental Protection Agency (EPA) began sponsoring a series of water quality models in response to the Clean Water Act. An example of these efforts was developed at the Southeast Water Laboratory, one of the first attempts to calibrate a surface runoff model with field data for a variety of chemical contaminants.

The attention given to surface runoff contaminant models has not matched the emphasis on pure hydrology models, in spite of their role in the generation of stream loading contaminant data. In the United States the EPA has had difficulty interpreting diverse proprietary contaminant models and has to develop its own models more often than conventional resource agencies, who, focused on flood forecasting, have had more of a centroid of common basin models.

I. Answer the questions:

1. Name the list of indicators of drinking water.What is the most important to your mind?
2. What do drinking water quality standards describe?
3. When is a hydrological transport model used?
4. What do we call runoff?
5. Why are hydrologic studies important in various respects?
6. Summarize text C in 10-15 sentences .

II. Translate the proverbs and sayings. Give your own situations with them:

1. If there were no clouds, we should not enjoy the sun
2. One cloud is enough to eclipse all the sun
3. Foggy ideas
4. A storm in a tea cup
5. Under stress of weather
6. After rain comes fair weather
7. Rain or shine

GRAMMAR

The Conditional sentences

Існує три основних типи умовних речень	
Умовні речення першого типу *(First Conditional)*	
if + present simple	**Future**
If you come at ten, *Якщо ти* ***прийдеш*** о десятій**,** If the weather is fine, *Якщо погода* ***буде*** *гарною,*	I **will be** ready to start. *я* ***буду готовий*** *вирушати.* we **will go** for a walk. *ми* ***підемо*** *на прогулянку***.**
Умовні речення другого типу (Second Conditional)	
If + past simple	**would/could/might +** **indefinite infinitive**
If you **came** at ten, ***Якби*** *ти* ***прийшов*** *о десятій,* ***If*** *the weather* ***was*** *fine,* **Якби** погода була ***гарною***, (сьогодні, завтра)	I would be ready to start. *я* ***б був готовий*** *вирушати.* we **would go for** a walk. *ми* ***б пішли*** *на прогулянку.*
Умовні речення третього типу (Third Conditional)	
if + past perfect	**would/could/might +** perfect infinitive
If you **had come** at ten, ***Якби*** ти ***прийшово*** *десятій,* **If** the weather **had been** fine, ***Якби*** *погода* ***була*** *гарною, (вчора)*	**I would have been** ready to start. я ***б був готовий*** вирушати. we would have gone for a walk. *ми* ***б пішли*** *на прогулянку***.**

Ex. 1 Розкрийте дужки, утворюючи *First, Second* **та** *Third Conditional* **від кожного речення. Перекладіть утворені речення.**

1. If she (to find out) the truth, she (to be) very happy.
2. I (to visit) him in the hospital, if I (to know) about his illness.
3. If we (not to like) his suggestion, we (to tell) him about it.
4. If John (to want) the advice, he (to ask) you.
5. If his sister (to have) better qualification, she (to be able to) apply for better job.
6. They (to find) the solution, if they (to understand) the problem.
7. If Beth (to go) to her native town, she (to be) happier.
8. If you (not to agree) with me, I (to go) to the director.
9. What you (to do), if he (tell) you to leave?

Ex.2 Перекладіть англійською мовою, використовуючи *First, Second* та *Third Conditional.*

1. Ти б почував себе краще, якби лягав спати раніше.
2. Він краще знав би англійську, якби читав побільше англійських книжок.
3. Якби вони прийшли раніше, вони змогли б зайняти кращі місця.

4. Ми б не запізнились на поїзд, якби взяли таксі.
5. Якщо піде дощ, діти залишаться вдома.
6. Якби вчора не було так холодно, ми поїхали б за місто.
7. Якщо ти попросиш брата, він відремонтує твій велосипед.
8. Якщо він вивчить німецьку мову, він читатиме в оригіналі німецьких авторів.

Ex. 3 Розкрийте дужки, використовуючи дієслова в потрібній формі.

1. If I (to have) time tonight, I (to finish) this book.
2. He (can) take you to the concert tomorrow if he (to have) a spare ticket.
3. If they (to have) plenty of time yesterday, they (to miss) the train.
4. If she (to leave) at seven o'clock, we (to ask) her to give us a lift.
5. If my friend (to phone) now, I (not to feel) so lonely.
6. If someone (to give) you a million, what you (to do)?
7. If you (to be able) to finish the job tomorrow, you (to have) a holiday.
8. If he (to check) the oil before driving, he (not to have) problems with the car.
9. If she (to be) here now, she (to help) you.
10. If they (to be) picked for our team, we (to win) the race next month.
11. The London fire never (to start) if the baker (to put) lilt oven out properly.
12. If somebody (to invite), you (to go) to the blind date?
13. If they (to stay) in Kyiv, they (to live) here for thirty years.
14. If I (to meet) him earlier, he (not to be) late for supper,
15. The baby (to wake up) if you (not to stop) speaking like that.

Зверніть увагу!

В додаткових підрядних реченнях, що залежали від дієслова ***(to wish)****, вживається* ***Past Subjunctive*** *(співпадає по формі з Past Indefinite) та* ***Past Perfect Subjunctive*** *(співпадає по формі з Past Perfect)*

I wish you **were** here. - *Я б хотів, щоб ти був тут.*

- *Шкода, що ти не тут.* (Second Conditional)

I wish I had not told **you the truth.** — *Шкода, що я розповів вам правду.* (Third Conditional)

- *Добре було б, якби я не розповів вам правду.*

I wish he **would agree** to go there. - *Я б хотів, щоб він погодив ся поїхати туди.* (Would + *Infinitive)*

Ex. 4 Перепишіть речення, використовуючи *"I wish" + Past Subjunctive.* **Перекладіть їх українською мовою.**

1. I'd love to know five foreign languages.
2. Why don't they have a bigger flat?
3. Why don't we go to the restaurant more often?
4. She hates going to school on Saturdays.
5. She'd love to study to cook.

6. I'd like to live in Australia.
7. He hates doing housework every day.

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*Зверніть увагу, що в додаткових підрядних реченнях, які залежать від дієслова **to wish**, вживається **would + infinitive**, якщо ми хочемо висловити бажання про те, щоб ситуація змінилася або зараз, або в майбутньому, хоча не дуже сподіваємось на це.*

В більшості випадків зміна ситуації не залежить від особи, що висловлює побажання.

I **wish** + subject + **would** + infinitive

I **wish he would ring** me **up**.

Мені б хотілось, щоб він подзвонив мені.

Ex. 5 Перепишіть речення, використовуючи *"I wish + would + infinitive".* **Перекладіть їх українською мовою.**

1. Beth never comes home before eleven.
2. He doesn't wear uniform very often.
3. He doesn't speak French.
4. A1 doesn't agree with you.
5. I'd like John to stop smoking.
6. The child doesn't wash very often.
7. She is unkind to the visitors.
8. I don't like my son playing basketball all the time.

Ex. 6 Розкрийте дужки, вживаючи дієслова у відповідній формі.

1. If Beth (to go) to her home town, she could visit her parents.
2. If you (to be) still ill tomorrow, you will have to stay at home.
3. .If she (not to drink) coffee late at night, she would have been able to sleep.
4. She wouldn't have married him if she (to know) what he was like.
5. If he (to phone) tomorrow, please say we are out.
6. If they (to know) the significance of this event, they would be more alarmed.
7. If her son (to be born) two years earlier, he wouldn't have had to do military service.
8. If you (to look) everywhere for your passport, you will find it.
9. If Joe (to get up) earlier, he would get to institute on time.
10. If the fire (not to happen), their house wouldn't have been destroyed.
11. If the sound (not to be) so loud, she wouldn't be so nervous.
12. If the child (not to fall), he wouldn't have burst into tears.
13. If Barry (to come) to visit us for the weekend, we will be very glad.
14. If Jane (to be) more careful, she wouldn't have left her watch in the changing

room.

15.If he (not to leave) the door open, his cat wouldn't have eaten the fish.

Ex. 7 Розкрийте дужки, використовуючи *"Zero Conditional".* Перекладіть речення українською мовою.

1. Her child says hello if he (to see) you.
2. If the dog is angry, it always (to bark).
3. The toy (not to work) if the batteries are flat.
4. If the machine (not to have) enough oil, it doesn't work.
5. If you go in the best seats, you (to get) a free drink.
6. If the hot-air balloon (to be) filled with air, it rises.
7. The alarm (to raise) automatically if fire is discovered.
8. Water (to change) into ice if it (to freez).
9. If water boils, it (to change) into steam.
10. If she puts her money in a bank, she (to get) five per cent interest.

Ex.8 Перефразуйте речення, використовуючи *"I wish",*

1. I am not very fit.
2. We weren't together.
3. He was too upset that day.
4. They couldn't come here.
5. It's very hot today.
6. My parents are abroad.
7. It's snowing.
8. He has read my letter.
9. She doesn't know enough English.
10. My son didn't take my advice.
11. His room is untidy.
12. They wasted much time watching TV.
13. He doesn't have a lot of friends.
14. I can't swim.

Ex.9 Перекладіть англійською мовою, використовуючи *"I wish".*

1. Якби я мав вільний час зараз!
2. Шкода, що я запізнився на зустріч.
3. Якби я вмів малювати!
4. Шкода, що вона не знала відповіді на запитання.
5. Добре було б, якби у мене була відпустка зараз.
6. Шкода, що я послухав їхньої поради.
7. Жаль, що вони не змінили своєї думки.
8. Добре було б, якби ти знав правду.
9. Якби ти сказав мені про це рішення!
10. Шкода, що він не припинив робити такі помилки.
11. Жаль, що вона хворіє.

12. Шкода, що вже пізно йти на збори.
13. Вона шкодувала, що перестала працювати там.
14. Якби він вмів плавати!
15. Добре, було б, якби ви взяли участь в обговоренні цього проекту.
16. Шкода, що ти не застав мене вдома.
17. Жаль, що дитина не цікавиться історією.

Ex. 10 Перекладіть англійською мовою.

1. Шкода, що я вирішив працювати в цій фірмі.
2. Якби він мав час, він поїхав би у відпустку наступнош місяця.
3. Якби я був обачнішим, я вчора не відповідав би нм їхні питання без адвоката.
4. Шкода, що ми не пішли на вечірку.
5. Якби вона прийшла сюди сьогодні увечері, я в! поговорив з нею.
6. Якби ти їх попередив, вони б не зробили цього зараз.
7. Я б хотів бути сильнішим.
8. Якщо він перекладе цю статтю до кінця тижня, він віддасть її редактору.
9. Якби ти міг прожити життя знову, щоб ти робив?
10. Шкода, що він втратив всі свої гроші.
11. Якби ти був молодшим, ти взяв би участь в перегонах.
12. Якби я знав, що я захворію, я б не погодився на участь в конференції.
13. Я шкодую, що я не кінозірка.
14. Якби ми запросили няньку, вона б доглядала за нашим малюком.
15. Якби директор прийшов о третій, ми б обговорювали з ним ваші пропозиції вже сьогодні.

MODAL VERBS

can, could	
Виражає уміння, можливість, фізичну або розумову здатність виконати певну дію в теперішньому, майбутньому чи минулому.	
(можу, умію)	
I **can** do it now.	She **can** speak English.
*Я **можу** зробити це зараз.*	*Вона **вміє** розмовляти англійською мовою.*
I **cannot** do it.	She **cannot** speak French.
Я не можу зробити це.	*Вона не вміє розмовляти французькою мовою.*
	Can he swim?
	Він уміє плавати?
I **could** help him.	He **could** ski when he was
*Я зміг допомогти йому***.**	five.
	*Він **умів** кататися на лижах, коли йому було п'ять років.*

Ex. 11 Перекладіть англійською мовою, використовуючи *can/could* та *to be able to.*

1. Можливо, вони зможуть замовити квитки для вас.
2. Він вміє так швидко бігати з дитинства.
3. Вона взагалі не вміє плавати!
4. Коли він був молодшим, він міг танцювати кращо, ніж може зараз.
5. Півгодини я намагався відкрити двері, але не зміг.
6. Вона сказала, що не змогла приєднатись до нас, том що хворіла.
7. Ми будемо дуже раді, якщо зможемо допомогти вам
8. Вони змогли відвідати всі музеї за три дні.
9. Чому він ніколи не може лягти спати раніше?
10. Це вперше вони змогли досягти вершини гори.
11. Коли ти зможеш дати мені її адресу?
12. Чому поліція не змогла знайти викрадача?

Ex.12 Перекладіть англійською мовою, використовуючи *can* або *could* з різними формами інфінітива.

1. Невже вони зараз вдома?
2. Невже вона пішла?
3. Невже він працює над новою статтею?
4. Невже вона працює в школі вже десять років?
5. Невже ти віриш його історіям?
6. Невже він витратив всі гроші?
7. Невже вони досі сидять в тому кафе?
8. Невже вона любить ходити по музеях?
9. Невже він обідає вже годину?
10. Невже зараз грають у футбол?
11. Невже вона встає рано?
12. Невже він вивчає архітектуру шістнадцятого століття?

Ex. 13 Перекладіть англійською мовою, використовуючи *may, might, to be allowed to.*

1. Ви можете починати виконувати це завдання.
2. Ти не можеш розмовляти з ним так неввічливо.
3. Мені дозволили запросити на вечірку всіх моїх друзів.
4. Вам не можна пропускати лекції.
5. Кому з вас дозволили піти в похід?
6. Батьки сказали, що нам можна ходити на річку.
7. Я приїду до вас, як тільки мені дозволять.
8. Можна йому взяти участь в концерті?
9. Ми не впевнені, що нам дозволять здійснити цей проект.
10. Чому їй не дозволили відвідати хворого?
11. Студентам дозволять користуватись записами під час екзамену.

12. Коли дітям дозволять погратися на комп'ютері?
13. Як тільки йому виповниться шістнадцять, йому дозволять водити машину.
14. Як часто тобі дозволяють влаштовувати вечірки вдома?
15. Нікому не дозволили взяти участь в змаганні без дозволу лікаря.

Ex. 14. Вставте модальні дієслова *may* або *can*.
1. ... I come in?
2. He ... not go out because he is ill.
3. You ... translate this text; you don't know French enough.
4. Take the umbrella: it ... rain.
5. She ... visit us if she has time.
6. Do you think he ... answer all these questions?
7. …..she use your phone?
8. ... you help me just now?
9. I ... not find my key.
10. ... he drive a car if it is necessary to?

Ex. 15 Вставте модальні дієслова *may, might* або *can, could.*
1. He ... not find his notebook last night.
2. ... I come and see you tomorrow?
3. She said that she ... be late.
4. You ... stay in our house if you like.
5. I tried to see something in the darkness but I ... not.
6. Father said that I ... swim well enough.
7. ... I join you in the evening?
8. You ... take this job or rebuse.
9. You ... not believe.
10. ... you pass me juice, please?
11. They ... not help us because they were abroad.
12. We ... not imagine him without his motorbike.

Ex. 16 Перекладіть англійською мовою, використовуючи *to have to.*
1. Я повинен підготувати доповідь.
2. Ти не повинен іти пішки.
3. Він був змушений повернутись з відпустки раніше.
4. Їй не довелося працювати вночі.
5. Мені довелось повернути квитки в касу.
6. Ми повинні будемо нагадати їм про їхню обіцянку.
7. Їм не доведеться довго чекати.
8. Їй доведеться вибирати самій?
9. Ви не повинні вибачатись.
10. Чому ти був змушений розповісти про це?

Ex. 17 Використайте *must* або *to have to* в необхідній формі. Використовуйте

питальну або заперечну форми де необхідно.

1. She ... leave the party yesterday — she wasn't well.
2. He was late for work today because he ... visite the doctor first.
3. You ... borrow my things without asking.
4. We are sorry, you ... smoke here.
5. She said we ... wash all the windows in the house.
6. Since the new manager came, they... change their methods of research.
7. Her son is happy as he ... do his home task today.
8. I (not) ... speak German since I was at school.
9. The teacher told us that we ... answer all the questions.
10. He ... get up early on Monday if he wants to catch the bus.
11. Her brother has been ill. He ... stay in hospital since last week.

Ex.18 Перекладіть англійською мовою, використовую *must* з необхідною формою інфінітива.

1. Їй, напевно, років двадцять.
2. Напевно, він зараз відпочиває на пляжі.
3. Де моя ручка? Певно, її взяла моя сестра.
4. Діти, напевно, сплять.
5. Вони, певно, всю ніч дивились телевізор.
6. Він, певно, захворів.
7. Ти нічого не їв зранку. Ти, напевно, голодний.
8. Вони, напевно, були вдома вчора.
9. Ніхто не відповідає. Вона, певно, пішла.
10. Він, напевно, вже зробив свою доповідь.

Ex. 19 Перекладіть англійською мовою, використовуючи *must* або *to have to*.

1. Вона не повинна виконувати ваші вказівки.
2. Її батько, певно, лікар.
3. Які документи я мушу підписати?
4. О котрій годині ти повинен повертатись додому?
5. Я був змушений втрутитись.
6. Вони, певно, чекають на нас уже півгодини.
7. Він не мусить працювати на цю фірму.
8. Вона не змогла прийти до нас, вона мусила йти на курси англійської.
9. Напевно, він прожив у цій країні багато років.
10. Чому вона повинна користуватись цими ліками?
11. Я повинен буду прочитати цю книжку.
12. Певно, вони приїхали до Києва вчора.

Ex. 20 Перекладіть англійською мовою, використовуючи іо *be* іо у відповідній формі.

1. Я повинен зустріти їх в аеропорту.

2. Вони мали працювати по сім годин щодня.
3. Вона повинна прийти сюди ввечері.
4. їхній син повинен був закінчити курси в цьому році.
5. Вони мали повернутись з відрядження.
6. Він хотів замовити номер в готелі, але не замовив.
7. Вона повинна була підготувати лабораторію.
8. Ми повинні були зустрітись після роботи, але не зустрілись.
9. Відповідати на дзвінки має сестра.
10. Діти повинні були поїхати на екскурсію, але не поїхали.
11. Розклад має змінитись через три дні.

Ex. 21 Вставте модальні дієслова *to be to* або *to have to.*

1. I was late because I ... to finish my work.
2. Where ... the meeting to take place?
3. We ... to go home because our mother is waiting for us.
4. He ... to wear specs.
5. As it was decided, I... to write an essay about this country.
6. He ... to go to the dentist twice a week!
7. She insisted that the child ... to have lunch.
8. The agreement was that you ... there in time.
9. I am afraid you ... to find the solution to this problem.
10. He told that we ... to return his money in a month.

Ex. 22 Перекладіть англійською мовою, використовуючи *must, may, might* або *can't.*

1. Він, напевно, працює на цьому заводі.
2. Можливо, він працює на цьому заводі.
3. Він, можливо, працює на цьому заводі.
4. Не може бути, щоб він працював на цьому заводі.
5. Він, напевно, працював на цьому заводі.
6. Він, можливо, працював на цьому заводі.
7. Не може бути, щоб він працював на цьому заводі.
8. Вони, напевно, тренуються в спортивному клубі.
9. Можливо, вони тренуються в спортивному клубі.
10. Можливо, вони і тренуються в спортивному клубі.
11. Не може бути, що вони тренуються в спортивному клубі.
12. Напевно, вона в інституті.
13. Можливо, вона в інституті.
14. Можливо, вона і в інституті.
15. Не може бути, щоб вона була в інституті зараз.
16. Не може бути, щоб вона була в інституті вчора.
17. Можливо, вона була в інституті.

Ex. 23 Доповніть речення, використовуючи *should* або ***ought to.***

1. You ... follow instructions before taking medicine.
2. It’s very late. Children ... be in bed.
3. You ... not smoke here.
4. It’s his anniversary next week. Maybe we ... to sent him a telegram.
5. Her room is dirty. She ... clean it.
6. This hotel is very expensive. You ... not stay here.
7. She drives too fast. She ... drive carefully.
8. They ... not let the children see such films.
9. They invite us to have barbecue. ... we take something to eat?
10. You ... not read in the car. You may feel sick.
11. He ... book the tickets early in advance.

Ex. 24 Перекладіть англійською мовою, використовуючи *should* або *ought to* з *Perfect Infinitive.*

1. Адвокат каже, що йому не слід було підписувати контракт.
2. Тобі слід було відкласти всі зустрічі.
3. Дитині не слід було читати цю книжку.
4. Їй слід було залишити записку.
5. Тобі не слід було йти туди в такий пізній час.
6. Йому слід було записати адресу цієї контори.
7. Йому не слід було порушувати правила.
8. Їм слід було взяти таксі.
9. Що їй слід було робити?
10. Тобі слід було запропонувати свою допомогу.
11. Чому йому не слід було йти на ту вечірку?
12. Їм слід було краще піклуватися про їхній будинок. \
13. Їй не слід було слухати плітки.
14. Вам слід чітко виконувати всі розпорядження.

Ex. 25 Доповніть речення, використовуючи *should, ought to, must,* або *to have to.*

1. She ... be arriving in some hours.
2. He ... go home at nine because his father is waiting for him.
3. You ... try to find a new job.
4. Mother insisted that I ... have a meal.
5. Don’t you think he ... ask before taking my book without asking.
6. There are no planes today, so I ... to go by train.
7. He ... never say that again!
8. They ... book the tickets if they want to go to the concert.
9. We think you ... tell your parent you will be late.
10. He ... do what he says.
11. Do you think she ... tell my parents what happened?
12. You ... have a favourite pupil.

Ex. 26 Fill in the blanks with 'can',' may, 'must' or 'need'

1. Peter ... return the book to the library. We all want to read it.
2. Why ... not you understand it? It is so easy.
3. ... we do the exercise at once? — Yes, you .... do it at once.
4. ... you pronounce this sound?
5. You ... not have bought this meat: we have everything for dinner.
6. I ... not go out today: it is too cold.
7. ... I take your pen? — Yes, please.
8. We ... not carry the bookcase upstairs: it is too heavy.
9. We ... not carry the bookcase upstairs ourselves: the workers will come and do it.
10. When ... you come to see us? — I... come only on Sunday.
11. Shall I write a letter to him? — No, you ... not, it is not necessary.
12. ... you cut something without a knife?
13. Everything is clear and you ... not go into details now.
14. He ... not drink alcohol when be drives.
15. Don't worry! I... change a light bulb.
16. By the end of the week I... have finished writing my book.
17. She ... not call the doctor again unless she feels worse.

Ex. 27 Translate the following sentences into English concentrating on the use of *must, may,* and *can't.*

1. Поспішай: ти можеш спізнитися на потяг.
2. Він, можливо, захворів.
3. Він, можливо, хворіє.
4. Не може бути, що він забув купити квіти.
5. Не може бути, що він посварився з нею.
6. Наверное, вона дізналася про це від Маші.
7. Це, мабуть, була дуже важка задача.
8. На вулиці повинно бути дуже холодно.
9. Вона, мабуть, зустріла їх по дорозі додому.
10. Не може бути, що вони продали свій будинок.
11. Вони, можливо, приїдуть завтра.
12. Моя сестра, мабуть, зараз в бібліотеці.
13. Не може бути, що він зайняв перше місце.
14. Можливо, він і чув про це (хоча навряд).
15. Мама, мабуть, купила цукерки.
16. Вона, можливо, дзвонила мені вчора, а мене не було вдома.
17. Можливо, він і в школі зараз (хоча навряд).
18. Не може бути, що вона така молода. Їй повинне бути не менше тридцяти років.
19. Мабуть, навкруги вашого села ростуть густі ліси.
20. Не може бути, що він написав листа так швидко.

21. Можливо, ми підемо на пляж: погода чудова.
22. Це, очевидно, дуже стародавній рукопис.
23. Давайте подзвонимо Роберту: нам може знадобитися його порада.

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