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АНГЛИЙСКИЙ ЯЗЫК ДЛЯ МАГИСТРОВ ГИДРОМЕТЕОРОЛОГИЧЕСКИХ СПЕЦИАЛЬНОСТЕЙ

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Под ред. Н.В. Федосеевой.

Учебное пособие предназначено, главным образом, для магистров гидрометеорологических и смежных специальностей, готовящихся к сдаче экзамена по английскому языку. Оно представляет собой комплекс уроков, ориентированных на развитие навыков перевода, подробного и краткого пересказа текстов, подобранных из оригинальных англоязычных источников и организованных по их целевому назначению, грамматического справочника и ряда приложений справочного характера.

Тематика подобранного лексико-грамматического материала, охватывающего широкий круг дисциплин о Земле, компактный грамматический справочник и другие справочные материалы могут представлять интерес для студентов, магистров, а также для широкого круга читателей, имеющих дело с литературой на английском языке.

Fedoseyeva, N.V., Ignatyeva, N.V., Sedunova, O.Yu., Serova, L.P. A manual of English for Master's students of Hydrometeorology. – St Petersburg: RSHU Publishers, 2013. – 220 pp.

The handbook focuses on some English grammar and vocabulary basics as well as text translation and retelling techniques with a number of exercises and texts provided to develop the skills acquired. The teaching materials are built on the authentic books, articles and reference sources. The handbook was written with Master students of environmental studies in mind. It could be also useful for all those who are interested in Earth and Clime Change sciences.

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Предисловие

Учебное пособие предназначено, главным образом, для подготовки магистров, чьей специальностью являются науки о Земле, к сдаче экзамена по английскому языку. Тематика подобранного текстового материала, охватывающая широкий круг дисциплин о Земле, а также методические рекомендации по переводу и пересказу англоязычных научно-технических текстов, грамматический справочник, затрагивающий основные лексико-грамматические проблемы английского языка, и другие материалы справочного характера дают возможность использовать предлагаемое пособие для обучения студентов и магистров смежных специальностей. По этой же причине пособие может представлять интерес и для широкого круга читателей, имеющих дело с научной литературой на английском языке.

Пособие рассчитано на средний уровень владения английским языком.

Пособие состоит из восьми основных разделов, отражающих различные научные дисциплины, содержащих тексты для письменного перевода, подробного и краткого пересказа текстов, грамматического справочника и приложений. Все разделы дополнены упражнениями, направленными на закрепление полученных навыков.

Блок 1
SOLAR RADIATION AND GLOBAL ENERGY BUDGET

Lesson 1

Упражнение 1.

Прочитайте заголовок приводимого ниже текста. Подумайте, о чем в нем может идти речь. Приведите 10–15 слов, которые могут, с Вашей точки зрения, встретиться в тексте.

Прочитайте и переведите текст.

Solar radiation

The prime source of the energy injected into our atmosphere is the sun, which is continually shedding part of its mass by radiating waves of electromagnetic energy and high-energy particles into space. This constant emission is important because it represents in the long run almost all the energy available to the earth (except for a small amount emanating from the radioactive decay of earth minerals). The amount of energy received by the earth, assuming for the moment that there is no interference from the atmosphere, is affected by four factors: solar output, the sun-earth distance, the altitude of the sun, and day length.

1 Solar output

Solar energy, which originates from nuclear reactions within the sun's hot core ($16 \cdot 10^6$ K), is transmitted to the sun's surface by radiation and hydrogen convection. Visible solar radiation (light) comes from a 'cool' (~6,000 K) outer surface layer called the photosphere. Temperatures rise again in the outer chromosphere (10,000 K) and corona (10^6 K), which is continually expanding into space. The outflowing hot gases (plasma) from the sun, referred to as the solar wind (with a speed of $1.5 \cdot 10^6$ km hr^{-1}), interact with the earth's magnetic field and upper atmosphere. The earth intercepts both the normal electromagnetic radiation and energetic particles emitted by the sun during solar flares.

The sun behaves virtually as a black body, meaning that it both absorbs all energy received and in turn radiates energy at the maximum rate possible for a given temperature. The energy emitted at a particular

wavelength by a perfect radiator of given temperature is described by a relationship due to Max Planck. The total energy emitted by a black body is found by integration of Planck's equation, known as Stefan's Law:

$$F = \sigma T^4$$

where $\sigma = 5.67 \cdot 10^{-8}$ W m^{-2} K^{-2} (the Stefan-Boltzmann constant), i.e. the energy emitted (F) is proportional to the fourth power of the absolute temperature of the body (T).

The total solar output to space, assuming a temperature of 5,760 K for the sun, is $3.84 \cdot 10^{26}$ W, but only a tiny fraction of this is intercepted by the earth, because the energy received is inversely proportional to the square of the solar distance (150 million km).

The energy received at the top of the atmosphere on a surface perpendicular to the solar beam for mean solar distance is termed the solar constant. The most recent satellite measurements indicate a value of about 1,368 Wm^{-2}. For solar radiation, 8 per cent is ultraviolet and shorter wavelength emission, 39 per cent visible light (0.4–0.7 μm) and 53 per cent near-infrared (>0.7 μm). The mean temperature of the earth's surface is about 288 K (15 °C) and of the atmosphere about 250 K (–23 °C). Gases do not behave as black bodies, the absorption bands in the atmosphere cause its emission to be much less than that from an equivalent black body. The wavelength of maximum emission varies inversely with the absolute temperature of the radiating body.

Thus solar radiation is very intense and is mainly short-wave between about 0.2 and 4.0 μm, with a maximum (per unit wavelength) at 0.5 μm, whereas the much weaker 'terrestrial radiation has a peak intensity at about 10 μm and a range of about 4 to 100 μm (1 μm = 1 micrometre = 10^{-6} m).

Satellite data show that the solar constant undergoes small periodic variations of about 0.1 per cent, related to sunspot activity. Sunspots are dark (i.e. cooler) areas visible on the sun's surface. Their number and positions change in a regular manner, known as the sunspot cycles. These cycles have wavelengths averaging 11 years (varying in length between 8 and 13 years), the 22-year (Hale) magnetic cycle, much less importantly 37.2 years (18.6 years – the luni-solar oscillation) and possibly 80–90 years. Between the thirteenth and eighteenth centuries, sun-

spot activity was generally low, except for the periods AD 1350–1400, and 1600–1645. Output within the ultraviolet part of the spectrum shows considerable variability, with up to twenty times more ultraviolet radiation emitted at certain wavelengths during a sunspot maximum than during a sunspot minimum. The relation between sunspot activity and terrestrial temperatures is a matter of some dispute. However, some authorities believe that prolonged time- spans of sunspot minima (e.g. AD 1645-1705, the Maunder Minimum) and maxima (e.g. 1895–1940 and post 1970) can produce significant global cooling and warming, respectively.

Shorter-term relationships are more difficult to support, but mean annual temperatures have been correlated with the combined 10-11 and 18.6-year solar cycles. Satellite measurements during the 1980s, the latest solar cycle, show a small decrease in solar output as sunspot number approaches its minimum, and a subsequent recovery. Although sunspot areas are cool spots, they are surrounded by bright areas of activity known as faculae, which have higher temperatures; the net effect is for solar output to vary in parallel with the number of sunspots. Thus, the solar 'irradiance' decreases by about 1.5 Wm^{-2} from sunspot maximum to minimum. In the long term, assuming that the earth behaves as a black body, a long-continued difference of 2 per cent in the solar constant could change the effective mean temperature of the earth's surface by as much as 1.2 °C; however, the observed fluctuations of about 0.1 per cent would change the mean global temperature by ≤0.06 °C, based on calculations of radiative equilibrium.

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

Radiation, mass, electromagnetic, moment, solar, photosphere, chromosphere, corona, plasma, fraction, proportional, perpendicular, constant, ultraviolet, infrared, peak, intensity, periodical, regular, manner.

Упражнение 3.

Найдите в тексте из упражнения 1 слова с суффиксом *~ly*. Определите, какими частями речи они являются.

Упражнение 4.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний:

1. in the long run	a. обратно пропорциональный
2. the fourth power	b. двадцать раз
3. much less	c. ближний инфракрасный
4. in a regular manner	d. длинноволновая радиация
5. twenty times	e. радиоактивный распад
6. inversely proportional	f. четвертая степень
7. long-wave radiation	g. в общем
8. near-infrared	h. намного меньше
9. radioactive decay	i. регулярным образом

Упражнение 5.

Заполните таблицу, вставив недостающие части речи.

v.	n.	adj.	adv.
originate	radiation	particular	importantly
emit	oscillation		respectively

Упражнение 6.

Вставьте в пропуски в тексте соответствующие предлоги: *at, with, of, to, by, throughout, between, in, per, through*

Altitude of the sun

The altitude of the sun (i.e. the angle between its rays and a tangent to the earth's surface at the point of observation) also affects the amount ... solar radiation received …the surface … the earth. The greater the sun's altitude, the more concentrated is the radiation intensity … unit area … the earth's surface and the longer is the path length …the beam… the atmosphere, which increases the atmospheric absorption. There are, in addition, important variations … solar altitude …the proportion… radiation reflected … the surface, particularly … the

case… a water surface. The principal factors that determine the sun's altitude are, … course, the latitude … the site, the time … day and the season. … the June solstice, the sun's altitude is a constant 23 $^{1}/_{2}$°… the day … the North Pole and the sun is directly overhead … noon …the Tropic … Cancer (23 $^{1}/_{2}$ °N).

Упражнение 7.

Прочитайте текст и найдите в нем ответы на следующие вопросы:

1. Что является причиной сезонных изменений в поступлении солнечной энергии?
2. Когда Земля получает больше энергии от Солнца – в январе или в июле?
3. В каком полушарии зима должна быть теплее, а в каком – лето?
4. Почему в реальности наблюдается обратная картина?
5. В каком полушарии теплое полугодие более продолжительное?

(Контрольное время – 7 минут)

Distance from the sun

The annually changing distance of the earth from the sun produces seasonal variations in our receipt of solar energy. Owing to the eccentricity of the earth's orbit around the sun, the receipt of solar energy on a surface normal to the beam is 7 per cent more on 3 January at the perihelion than on 4 July at the aphelion. In theory (that is, discounting the interposition of the atmosphere and the difference in degree of conductivity between large land and sea masses), this difference should produce an increase in the effective January world surface temperatures of about 4 °C, over those of July. It should also make northern winters warmer than those in the southern hemisphere, and southern summers warmer than those in the northern hemisphere. In practice, atmospheric heat circulation and the effects of continentality substantially mask this global tendency, and the actual seasonal contrast between the hemispheres is reversed. Moreover, the northern summer half-year (21 March-22 September) is five days longer than the southern hemisphere summer (22 September-21 March). This difference slowly changes; about 10,000 years ago the aphelion occurred in the northern hemisphere winter, and northern summers received 3-4 per cent more radiation than today. This same pattern will return about 10,000 years from now.

Упражнение 8.

Выберите из текста *Distance from the sun* 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 9.

В каждом предложении текста *Distance from the sun* найдите подлежащее и сказуемое. Определите время и залог сказуемого.

Упражнение 10.

Переведите текст письменно.

(Контрольное время – 25 минут)

Length of day

The length of daylight also affects the amount of radiation that is received. Obviously, the longer the time that the sun shines the greater is the quantity of radiation that a given portion of the earth will receive. At the equator; for example, the day length is close to 12 hours in all months, whereas at the poles it varies between 0 and 24 hours from winter (polar night) to summer. The polar regions receive their maximum amounts of solar radiation during their summer solstices, which is the period of continuous day. The amount received during the December solstice in the southern hemisphere is theoretically greater than that received by the northern hemisphere during the June solstice, due to the previously mentioned elliptical path of the earth around the sun. The equator has two radiation maxima at the equinoxes and two minima at the solstices, due to the apparent passage of the sun during its double annual movement between the northern and southern hemispheres.

Упражнение 11.

Составьте 5 общих вопросов к тексту *Length of day***.**

Упражнение 12.

(Парная работа) Ответьте на вопросы, составленные в упражнении 11.

Lesson 2

Упражнение 1.

Подумайте и приведите 10–15 слов, которые могут встретиться в тексте.

Прочитайте и переведите текст.

Energy transfer within the earth-atmosphere system

The distribution of solar radiation is often described as if it were all available at the earth's surface. This is, of course, an unreal view because of the effect of the atmosphere on energy transfer. Heat energy can be transferred by the three following mechanisms:

1 Radiation: Electromagnetic waves transfer energy (both heat and light) between two bodies, without the necessary aid of an intervening material medium, at a speed of $300 \cdot 10^6$ m s^{-1} (i.e. the speed of light). This is so with solar energy through space, whereas the earth's atmosphere allows the passage of radiation only at certain wavelengths and restricts that at others.

Radiation entering the atmosphere may be absorbed by atmospheric gases in certain wavelengths but most shortwave radiation is transmitted without absorption. Scattering occurs if the direction of a photon of radiation is changed by interaction with atmospheric gases and aerosols. Two types of scattering are distinguished. For gas molecules smaller than the radiation wavelength (λ), Rayleigh scattering occurs in all directions and is proportional to $(1/\lambda^4)$. As a result, the scattering of blue light ($\lambda \cong 0.4$ μm) is an order of magnitude (i.e. ×10) greater than that of red light ($\lambda \cong 0.7$ μm), thus creating the daytime blue sky. However, when water droplets or aerosol particles, with similar sizes (0.1–0.5 μm radius) to the radiation wavelength, are present, most of the light is scattered forward. This Mie scattering gives the greyish appearance of polluted atmospheres.

Within a cloud, or between low clouds and a snow-covered surface, radiation undergoes multiple scattering. In the latter case, the 'white out' conditions typical of polar regions in summer (and mid-latitude snowstorms) are experienced, when surface features and the horizon become indistinguishable.

2 Conduction: By this mechanism, the heat passes through a substance from point to point by means of the transfer of adjacent molecular motions. Since air is a poor conductor, this type of heat transfer can be virtually neglected in the atmosphere, but it is important in the ground.

3 Convection: This occurs in fluids (including gases), which are able to circulate internally and distribute heated parts of the mass. The low viscosity of air and its consequent ease or motion makes this the chief method of atmospheric heat transfer. It should be noted that forced convection (mechanical turbulence) occurs due to the development of eddies as air flows over uneven surfaces, even when there is no surface heating to set up free (thermal) convection.

Convection transfers energy in two forms. The first is the sensible heat content of the air (called enthalpy by physicists), which is transferred directly by the rising and mixing of warmed air. It is defined as c_pT, where T is the temperature and c_p (= 1,004 J kg^{-1} K^{-1}) is the specific heat at constant pressure (the heat absorbed by unit mass for unit temperature increase). Sensible heat is also transferred by conduction. The second form of energy transfer by convection is indirect, involving latent heat. Here, there is a phase change but no temperature change. Whenever water is converted into water vapour by evaporation (or boiling), heat is required. This is referred to as the latent heat of vaporization (L). At 0 °C, L is $2.50 \cdot 10^6$ J kg^{-1} of water. More generally,

$$L(10^6 \mathrm{J kg^{-1}}) \approx (2.5 - 0.0023T)$$

where T is in °C. When water condenses in the atmosphere, the same amount of latent heat is given off as is used for evaporation at the same temperature. Similarly, for melting ice at 0 °C, the latent heat of fusion is required, which is $0.335 \cdot 10^6$ J kg^{-1}. If ice evaporates without melting, the latent heat of this sublimation process is $2.83 \cdot 10^6$ J kg^{-1} at 0 °C (i.e. the sum of the latent heats of melting and vaporization). In all of these phase changes of water there is an energy transfer.

Упражнение 2.

Найдите в тексте термины, соответствующие следующим выражениям.

limit (v)	indiscernible	pierce	matter
look (n)	transfer (v)	inner	incoming (pres.)
common	for (conj)	rough	

Упражнение 3.

Словам в левой колонке подберите антонимы в правой колонке.

1. smaller	a. former
2 poor	b. optional
3. free	c. different
4. directly	e greater
5. same	f. should
6. necessary	g. forced
7. may	h. good
8. latter	i. indirectly

Упражнение 4.

Переведите следующие слова на русский язык.

Without	whenever	so	by	both … and …
by means of	uneven	forward	most of	smaller than
more generally	similarly	internally	or	as a result

Упражнение 5.

Из слов в правой и левой колонке образуйте цепочки существительных.

heat	change
energy	feature
radiation	development
water	interaction
surface	energy
phase	transfer
eddy	droplet
gas	wavelength

Упражнение 6.

Образуйте причастия 1 и 2 рода из следующих глаголов. Найдите примеры таких причастий в тексте из упражнения 1.

Restrict, occur, undergo, circulate, distribute, flow, transfer, condense.

Упражнение 7.

Прочитайте текст. (Контрольное время – 5 минут)

Effect of the atmosphere

Solar radiation is virtually all in the short-wavelength range, less than 4 μm. About 18 per cent of the incoming energy is absorbed by ozone and water vapour. Ozone absorption is concentrated in three solar spectral bands (0.20-0.31, 0.31-0.35 and 0.45-0.85 μm) while water vapour absorbs to a lesser degree in several bands between 0.9 and 2.1 μm. Solar wavelengths shorter than 0.285 μm scarcely penetrate below 20 km altitude, whereas those >0.295 μm reach the surface. Thus, the 3 mm (equivalent) column of stratospheric ozone attenuates ultraviolet radiation almost entirely except for a partial window around 0.20 μm, where radiation reaches the lower stratosphere. About 30 per cent is immediately reflected back into space from the atmosphere, clouds and the earth's surface, leaving about 70 per cent to heat the earth and its atmosphere. Of this, the greater part eventually heats the atmosphere, but much of this heat is received by the atmosphere via the earth's surface. The ultimate retention of this energy by the atmosphere is of prime importance, because if it did not occur the average temperature of the earth's surface would fall by some 40°C, obviously making most life impossible. The surface absorbs almost half of the incoming energy available at the top of the atmosphere and reradiates it outwards as infrared waves of greater than 3 μm. Much of this reradiated long-wave energy can be absorbed by the water vapour, carbon dioxide and ozone in the atmosphere, the rest escaping through atmospheric windows back into outer space, mainly between 8 and 13 μm.

Упражнение 8.

Ответьте на следующие вопросы, исходя из информации в тексте:

1. Какие газы наиболее интенсивно поглощают приходящее солнечное излучение?
2. Излучение в каком диапазоне длин волн не проникает ниже 20 км высоты?
3. Какая часть приходящего солнечного излучения отражается атмосферой, облаками и поверхностью земли?
4. Что называется вторичным тепловым излучением земли?

Упражнение 9.
Выпишите 10 ключевых слов из текста в упражнении 8.

Упражнение 10
Письменно переведите текст. (Контрольное время – 30 минут)

Almost all energy affecting the earth is derived from solar radiation, which is of shortwave-length (<4 μm) due to the high temperature of the sun (~6,000 K) (i.e. Wien's Law). The solar constant has a value of approximately 1,370 W m^{-2}. The sun and the earth radiate almost as black bodies (Stefan's Law, $F = \sigma T^4$), whereas the atmospheric gases do not. Terrestrial radiation, from an equivalent black body, amounts to only about 270 W m^{-2} due to its low radiating temperature (263 K), and it is infrared (longwave) radiation between 4 and 100 μm. Water vapour and carbon dioxide are the major absorbing gases for infrared radiation, whereas the atmosphere is largely transparent to solar radiation (the greenhouse effect). Trace gas increases are now augmenting the 'natural' greenhouse effect (33 K). Solar radiation is lost by reflection, mainly from clouds, and by absorption (largely by water vapour). The planetary albedo is 31 per cent; 48 per cent of the extraterrestrial radiation reaches the surface. The atmosphere is heated primarily from the surface by the absorption of terrestrial infrared radiation and by turbulent heat transfer. Temperature usually decreases with height at an average rate of about 6.5 °C/km in the troposphere. In the stratosphere and thermosphere, it increases with height due to the presence of radiation absorbing gases.

The excess of net radiation in lower latitudes leads to a poleward energy transport from tropical latitudes by ocean currents and by the atmosphere. This is in the form of sensible heat (warm air masses/ocean water) and latent heat (atmospheric water vapour). Air temperature at any point is affected by the incoming solar radiation and other vertical energy exchanges, surface properties (slope, albedo, heat capacity), land and sea distribution and elevation, and also by horizontal advection due to air mass movements and ocean currents.

Блок 2
ATMOSPHERIC COMPOSITION, STRUCTURE AND CIRCULATION

Lesson 1

Упражнение 1.

Прочитайте заголовок приводимого ниже текста. Подумайте, о чем в нем может идти речь. Приведите 10–15 слов, которые могут, с Вашей точки зрения, встретиться в тексте.

Прочитайте и переведите текст.

Composition of the atmosphere

Air is a mechanical mixture of gases, not a chemical compound. Nitrogen, oxygen and argon account for 99.9 per cent of the air by volume. Moreover, rocket observations show that these gases are mixed in remarkably constant proportions up to about 80 km (50 miles).

Of especial significance, despite their relative scarcity, are the so-called greenhouse gases, which play an important role in the thermodynamics of the atmosphere by trapping long-wave terrestrial reradiation, producing the greenhouse effect. The concentrations of these gases are particularly susceptible to human (i.e. anthropogenic) activities.

1. Carbon dioxide (CO_2) is involved in a complex global cycle. It is released from the interior of the earth and produced by respiration of biota, soil processes, combustion and oceanic evaporation. Conversely, it is dissolved in the oceans and consumed by the process of plant photosynthesis.

2. Methane (CH_4) is produced primarily through anaerobic (i.e. oxygen-deficient) processes by natural wetlands and rice paddies (together about 40 per cent of the total), as well as by enteric fermentation in animals, by termites, through coal and oil extraction, biomass burning, and from landfills.

$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_20$$

Almost two-thirds of the total is related to anthropogenic activity. Methane is oxidized to CO_2 and H_2O by a complex photochemical reaction system.

$$CH_4 + O_2 + 2x \rightarrow CO_2 + 2x\ H_2$$

where x denotes any specific methane destroying species (such as H, OH, NO, Cl or Br).

3 Nitrous oxide (N_2O) is produced by biological mechanisms in the oceans and soils, by industrial combustion, automobiles, aircraft, biomass burning, and as a result of the use of chemical fertilizers. It is destroyed by photochemical reactions in the stratosphere involving the production of nitrogen oxides (NO_x).

4 Ozone (O_3) is produced by the high-level breakup of oxygen molecules by solar ultraviolet radiation and destroyed by reactions involving nitrogen oxides and chlorine (Cl) (the latter generated by CFCs, volcanic eruptions and vegetation burning) in the middle and upper stratosphere.

5 Chlorofluorocarbons (CFCs: chiefly $CFC1_3$(F-11) and CF_2C1_3(F-12)) are entirely anthropogenically produced by aerosol propellants, refrigerator coolants (e.g. 'freon'), cleansers and air conditioners, and were not present in the atmosphere until the 1930s. CFC molecules rise slowly into the stratosphere and then move poleward, being decomposed by photochemical processes into chlorine after an estimated average lifetime of some 65-130 years.

6 Hydrogenated halocarbons (HFCs and HCFCs) are also entirely anthropogenic gases. They have increased sharply in the atmosphere over the last few decades, following their use as substitutes for CFCs. Trichloroethane ($C_2H_3C1_3$), for example, which is used in dry-cleaning and degreasing agents, increased fourfold in the 1980s and has a seven-year residence time in the atmosphere. They generally have lifetimes of a few years, but still have substantial greenhouse effects.

Water vapour (H_2O), the primary greenhouse gas, is a vital atmospheric constituent. It averages about 1 per cent by volume but is very variable both in space and time, being involved in a complex global hydrological cycle.

In addition to the greenhouse gases, important reactive gas species are produced by the cycles of sulphur, nitrogen and chlorine. These play key roles in acid precipitation and in ozone destruction. Sources of these species are as follows:

Nitrogen species. The reactive species of nitrogen are nitric oxide (NO) and nitrogen dioxide (NO_2).

NO_x refers to these and other odd nitrogen species with oxygen. Fossil fuel combustion (approximately two-thirds for heating, one-third for cars and other transport) is the primary source of NO_x (mainly NO) accounting for $15–25 \cdot 10^9$ kg N/year. Biomass burning and lightning activity are other important sources. NO_x emissions increased by some 200 per cent between 1940 and 1980. The total source of NO_x is about $40 \cdot 10^9$ kg N/year. About 25 per cent of this goes into the stratosphere, where it undergoes photochemical dissociation. It is also removed as nitric acid (HNO_3) in snowfall. Odd nitrogen is also released as NH_x by ammonia oxidation in fertilizers and by domestic animals ($6–10 \cdot 10^9$ kg N/year).

Sulphur species. Reactive species are sulphur dioxide (SO_2) and reduced sulphur (H_2S, DMS). Atmospheric sulphur is almost entirely anthropogenic in origin: 90 per cent from coal and oil combustion, and much of the remainder from copper smelting. The major sources are sulphur dioxide ($80–100 \cdot 10^9$ kg S/year), hydrogen sulphide (H_2S) ($20-40 \cdot 10^9$ g S/year) and dimethyl sulphide (DMS) ($35–55 \cdot 10^9$ kg S/year). DMS is primarily produced by biological productivity near the ocean surface. SO_2 emissions increased by about 50 per cent between 1940 and 1980. Volcanic activity releases approximately 10^9 kg S/year as sulphur dioxide. Because the lifetime of SO_2 and H_2S in the atmosphere is only about one day, atmospheric sulphur occurs largely as carbonyl sulphur (COS), which has a lifetime of about one year. The conversion of H_2S gas to sulphur particles is an important source of atmospheric aerosols.

Despite its short lifetime, sulphur dioxide is readily transported over long distances. It is removed from the atmosphere when condensation nuclei of SO_2 are precipitated as acid rain containing sulphuric acid (H_2SO_4). The acidity of fog deposition can be more serious because up to 90 per cent of the fog droplets may be deposited. In Californian coastal fogs, pH values of only 2.0–2.5 are not uncommon. Peak pH readings in the eastern United States and Europe are < 4.3 (pH = 7 is neutral). In these areas and central southern China, rainfall deposits > 1 g m^{-2} of SO_2 annually.

There are also significant quantities of aerosols in the atmosphere. These are suspended particles of sea salt, mineral dust (particularly silicates), organic matter and smoke. Aerosols enter the atmosphere from a variety of natural and anthropogenic sources. Some originate as particles - soil grains and mineral dust from dry surfaces, carbon soot from coal fires and biomass burning, and volcanic dust. Others are converted into particles from inorganic gases (sulphur from anthropogenic SO_2 and natural H_2S; ammonium salts from NH_3; nitrogen from NO_x). Sulphate aerosols, two-thirds of which come from coal-fired power station emissions, are now playing an important role in countering global warming effects by reflecting incoming solar radiation. Other aerosol sources are sea salts and organic matter (plant hydrocarbons and anthropogenically derived). Natural sources are about eight times larger than anthropogenic ones on a global scale, but the estimates are wide-ranging. Moreover, there is considerable spatial variability. For example, some 1,500 Tg (10^{12} g) of crustal material is picked up by the air annually, about one-half from the Sahara and the Arabian Peninsula. Most of this is deposited downwind over the Atlantic. Large particles originate from mineral dust, sea salt spray, fires and plant spores; these sink rapidly back to the surface or are washed out (scavenged) by rain after a few days. Small (Aitken) particles form by the condensation of gas-phase reaction products and from organic molecules and polymers, including natural and synthetic fibres, plastics, rubber, and vinyl. Fine particles from volcanic eruptions may reside in the stratosphere above the level of weather processes for 1–3 years. Intermediate-sized particles originate from natural sources, such as soil surfaces, from combustion, or they accumulate by random coagulation and by repeated cycles of condensation and evaporation. Particles with diameters of 0.1–1.0 μm are highly effective in scattering solar radiation, and those of about 0.1 μm diameter are important in cloud condensation.

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

Chemical, concentration, fermentation, anthropogenic, specific, reaction, molecule, gas, role, distance, condensation, central, mineral, spore, process, aerosol, ozone, methane, conversion, effect.

Упражнение 3.

Найдите в тексте из упражнения 1 слова с суффиксами *~al/~ial, ~able, ~ive, ~le,~ant, ~ic*. Определите, к какой части речи они относятся.

Упражнение 4.

Найдите в тексте примеры следующих частей речи.

v.	n.	adj.	adv.	num.	prep.	part.

Упражнение 5.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний:

1. oxyden molecule	a. морская соль
2. residence time	b. электростанция
3. coal combustion	c. частица почвы
4. condensation nuclei	d. погодные процессы
5. fog droplets	e. молекула кислорода
6. sea salt	f. капли тумана
7. soil grain	g. сжигание угля
8. power station	h. ядра конденсации
9. weather processes	i. время жизни

Упражнение 6.

Переведите следующие слова на русский язык:

Moreover, particularly, complex, conversely, primarily, through, almost, after, entirely, sharply, in addition to, despite, others.

Упражнение 7.

Прочитайте текст и найдите в нем ответы на следующие вопросы:

1. Почему водяной пар и озон влияют на тепловой баланс атмосферы?
2. Каковы основные источники водяного пара?
3. На какой высоте главным образом формируется озон?
4. На какой высоте в низких и высоких широтах находится озоновый слой?

(Контрольное время – 15 минут)

Variation with height

The light gases (hydrogen and helium especially) might be expected to become more abundant in the upper atmosphere, but large-scale turbulent mixing of the atmosphere prevents such diffusive separation even at heights of many tens of kilometres above the surface. The height variations that do occur are related to the source-locations of the two major non-permanent gases – water vapour and ozone. Since both absorb some solar and terrestrial radiation, the heat budget and vertical temperature structure of the atmosphere are considerably affected by the distribution of these two gases.

Water vapour comprises up to 4 per cent of the atmosphere by volume (about 3 per cent by weight) near the surface, but only 3-6 ppmv (parts per million by volume) above 10 to 12 km. It is supplied to the atmosphere by evaporation from surface water or by transpiration from plants and is transferred upwards by atmospheric turbulence. Turbulence is most effective below about 10 km and as the maximum possible water vapour density of cold air is anyway very low, there is little water vapour in the upper layers of the atmosphere.

Ozone (O_3) is concentrated mainly between 15 and 35 km. The upper layers of the atmosphere are irradiated by ultraviolet radiation from the sun, which causes the break-up of oxygen molecules at altitudes above 30 km (i.e. $O_2 \rightarrow O + O$). These separated atoms (O + O) may then combine individually with other oxygen molecules to create ozone, as illustrated by the simple photochemical scheme:

$$O_2 + O + M \rightarrow O_3 + M$$

where *M* represents the energy and momentum balance provided by collision with a third atom or molecule. Such three-body collisions are rare at 80 to 100 km because of the very low density of the atmosphere, while below about 35 km most of the incoming ultraviolet radiation has already been absorbed at higher levels. Therefore ozone is mainly formed between 30 and 60 km, where collisions between O and O_2 are more likely. Ozone itself is unstable; its abundance is determined by three distinctly different photochemical interactions. Above 40 km odd oxygen is destroyed primarily by a cycle involving molecular oxygen; between 20 and 40 km NO_x cycles are dominant; while below 20 km a hydrogen-oxygen radical (HO_2) is responsible. Additional important cycles involve chlorine (ClO) and bromine (BrO) chains at various alti-

tudes. Collisions with monatomic oxygen may recreate oxygen, but ozone is mainly destroyed through cycles involving catalytic reactions, some of which are photochemical associated with longer wavelength ultraviolet radiation (2.3-2.9 μm). The destruction of ozone involves a recombination with atomic oxygen, causing a net loss of the odd oxygen. This takes place through the catalytic effect of a radical such as OH (hydroxyl):

$$\left.\begin{aligned} H + O_2 &\rightarrow HO_2 \\ HO_2 + O &\rightarrow OH + O_2 \\ OH + O &\rightarrow H + O_2 \end{aligned}\right\} \text{ net: } 2O \rightarrow O_2$$

The odd hydrogen atoms and OH result from the dissociation of water vapour, molecular hydrogen and methane (CH_4).

Stratospheric ozone is similarly destroyed in the presence of nitrogen oxides (NO_x, i.e. NO_2 and NO) and chlorine radicals (Cl, ClO). The source gas of the NO_x is nitrous oxide (N_2O), which is produced by combustion and fertilizer use, while chlorofluoro-carbons (CFCs), manufactured for 'freon', give rise to the chlorines. These source gases are transported into the stratosphere from the surface and are converted by oxidation into NO_x, and by UV photodecomposition into chlorine radicals, respectively.

The chlorine chain involves:

$$2\,(Cl + O_3 \rightarrow ClO + O_2)$$
$$ClO + ClO \rightarrow C1_2O_2$$

and

$$Cl + O_3 \rightarrow ClO + O_2$$
$$OH + O_3 \rightarrow HO_3 + 2O_2$$

Both reactions result in a conversion of O_3 to O_2 and the removal of all odd oxygens. Another cycle may involve an interaction of the oxides of chlorine and bromine. It appears that the increases of CR and Br species during the decades 1970-90 are sufficient to explain the observed decrease of stratospheric ozone over Antarctica. A mechanism that may enhance the catalytic process involves polar stratospheric clouds. These can form readily during the austral spring (October), when temperatures decrease to 185-195 K, permitting the formation of particles of nitric acid (HNO_3) ice and water ice. It is apparent, however, that anthropogenic sources of the trace gases are a primary factor in

the ozone decline. Conditions in the Arctic are somewhat different as the stratosphere is warmer and there is more mixing of air from lower latitudes.

The constant metamorphosis of oxygen to ozone and from ozone back to oxygen involves a very complex set of photochemical processes, which tend to maintain an approximate equilibrium above about 40 km. However, the ozone mixing ratio is at its maximum at about 35 km, whereas maximum ozone concentration occurs lower down, between 20 and 25 km in low latitudes and between 10 and 20 km in high latitudes. This is the result of some circulation mechanism transporting ozone downwards to levels where its destruction is less likely, allowing an accumulation of the gas to occur. Despite the importance of the ozone layer, it is essential to realize that if the atmosphere were compressed to sea level (at normal sea-level temperature and pressure) ozone would contribute only about 3 mm to the total atmospheric thickness of 8 km.

Упражнение 8.

Выберите из текста *Variation with height* 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 9.

Переведите текст письменно. (Контрольное время – 30 минут)

Variations with latitude and season

Variations of atmospheric composition with latitude and season are particularly important in the case of water vapour and ozone.

Ozone content is low over the equator and high in subpolar latitudes in spring. If the distribution were solely the result of photochemical processes, the maximum would occur in June near the equator, and the anomalous pattern must be due to a poleward transport of ozone. The movement is apparently from higher levels (30-40 km) in low latitudes towards lower levels (20-25 km) in high latitudes during winter months. Here the ozone is stored during the polar night, giving rise to an ozone-rich layer in early spring under natural conditions. It is this springtime feature that has been disrupted by the Antarctic ozone 'hole'.

The type of circulation responsible for this transfer is not yet known with certainty, although it does not seem to be a simple direct one.

The water vapour content of the atmosphere is closely related to air temperature and is therefore greatest in summer and in low latitudes. There are, however, obvious exceptions to this generalization, such as the tropical desert areas of the world.

The carbon dioxide content of the air (averaging almost 360 parts per million (ppm)) has a large seasonal range in higher latitudes in the northern hemisphere associated with photosynthesis and decay of the biosphere. At 50 °N, the concentration ranges from 351 ppm in late summer to 363 ppm in spring. The low summer values are related to the assimilation of CO_2 by the cold polar seas. Over the year, a small net transfer of CO_2 from low to high altitudes takes place to maintain an equilibrium content in the air.

Упражнение 10.

Составьте 5 общих вопросов к тексту *Variations with latitude and season.*

Упражнение 11.

(Парная работа) Ответьте на вопросы, составленные в упражнении 11.

Lesson 2

Упражнение 1.

Попытайтесь вспомнить, что Вам известно о структуре атмосферы Земли.

Подумайте и приведите 10–15 слов, которые могут встретиться в тексте.

Прочитайте и переведите текст.

The layering of the atmosphere

The atmosphere can be divided conveniently into a number of rather well-marked horizontal layers, mainly on the basis of temperature. The evidence for this structure comes from regular rawinsonde (radar wind-sounding) balloons, radio-wave investigations, and, more recently, from rocket flights and satellite sounding systems. Broadly, the pattern consists of three relatively warm layers (near the surface; between 50 and 60 km; and above about 120 km) separated by two relatively cold layers (between 10 and 30 km; and 80-100 km).

1 Troposphere

The lowest layer of the atmosphere is called the troposphere. It is the zone where weather phenomena and atmospheric turbulence are most marked, and it contains 75 per cent of the total molecular or gaseous mass of the atmosphere and virtually all the water vapour and aerosols. Throughout this layer, there is a general decrease of temperature with height at a mean rate of about 6.5 °C/km. The decrease occurs because air is compressible and its density decreases with height, allowing rising air to expand and thereby cool. Additionally, the atmosphere is heated mainly by turbulent heat transfer from the surface, not by absorption of radiation. The troposphere is capped in most places by a temperature inversion level (i.e. a layer of relatively warm air above a colder one) and in others by a zone that is isothermal with height. The troposphere thus remains to a large extent self-contained, because the inversion acts as a 'lid' that effectively limits convection. This inversion level or weather ceiling is called the tropopause. Its height is not constant in either space or time. It seems that the height of the tropopause at any point is correlated with sea level temperature and pressure,

which are in turn related to the factors of latitude, season and daily changes in surface pressure. There are marked variations in the altitude of the tropopause with latitude, from about 16 km at the equator, where there is great heating and vertical convective turbulence, to only 8 km at the poles.

The meridional temperature gradients in the troposphere in summer and winter are roughly parallel, as are the tropopauses, and the strong lower mid-latitude temperature gradient in the troposphere is reflected in the tropopause breaks. In these zones, important interchanges can occur between the troposphere and stratosphere, and vice versa. Traces of water vapour probably penetrate into the stratosphere by this means, while dry, ozone-rich stratospheric air may be brought down into the mid-latitude troposphere. For example, above-average concentrations of ozone are observed in the rear of mid-latitude low-pressure systems, where the tropopause elevation tends to be low. Both facts are probably the result of stratospheric subsidence, which warms the lower stratosphere and causes downward transfer of the ozone.

2 Stratosphere

The second major atmospheric layer is the stratosphere, which extends upwards from the tropopause to about 50 km. Although the stratosphere contains much of the total atmospheric ozone (it reaches a peak density at approximately 22 km), the maximum temperatures associated with the absorption of the sun's ultraviolet radiation by ozone occur at the stratopause, where temperature may exceed 0 °C. The air density is much less here, so even limited absorption produces a large temperature increase. Temperatures increase fairly generally with height in summer, with the coldest air at the equatorial tropopause. In winter, the structure is more complex with very low temperatures, averaging -80 °C, at the equatorial tropopause, which is highest at this season. Similar low temperatures are found in the middle stratosphere at high latitudes, whereas over 50-60 °N there is a marked warm region with nearly isothermal conditions at about -45 to -50 °C. Marked seasonal changes of temperature affect the stratosphere. The cold 'polar night' winter stratosphere often undergoes dramatic sudden warmings associated with subsidence due to circulation changes in late winter or early spring, when temperatures at about 25 km may jump from -80 to

-40°C over a two-day period. The autumn cooling is a more gradual process. In the tropical stratosphere, there is a quasi-biennial (26-month) wind regime, with easterlies in the layer 18 to 30 km for 12 to 13 months, followed by westerlies for a similar period. The reversal begins first at high levels and takes approximately 12 months to descend from 30 to 18 km (10 to 60 mb).

How far these events in the stratosphere are linked with temperature and circulation changes in the troposphere, remains a topic of meteorological research. Any interactions that do exist, however, are likely to be complex, otherwise they would already have become evident.

3 Mesosphere

Above the stratopause, average temperatures decrease to a minimum of about -133 °C (140 K) or around 90 km. This layer is commonly termed the mesosphere, although it must be noted that as yet there is no universal acceptance of terminology for the upper atmospheric layers. The layers between the tropopause and the lower thermosphere are now commonly referred to as the middle atmosphere, with the upper atmosphere designating the regions above about 100 km altitude. Above 80 km, temperatures again begin rising with height and this inversion is referred to as the 'mesopause'. Molecular oxygen and ozone absorption bands contribute to heating around 85 km altitude. It is in this region that 'noctilucent clouds' are observed over high latitudes in summer. Their presence appears to be due to meteoric dust particles, which act as ice crystal nuclei when traces of water vapour are carried upwards by high-level convection caused by the vertical decrease of temperature in the mesosphere. However, their formation is also thought to be related to the production of water vapour through the oxidation of atmospheric methane, since apparently they were not observed prior to the Industrial Revolution.

Pressure is very low in the mesosphere, decreasing from about 1 mb at 50 km to 0.01 mb at 90 km.

4 Thermosphere

Above the mesopause, atmospheric densities are extremely low, although the tenuous atmosphere still effects drag on space vehicles above 250 km. The lower portion of the thermosphere is composed

mainly of nitrogen (N_2) and oxygen in molecular (O_2) and atomic (O), forms, whereas above 200 km atomic oxygen predominates over nitrogen (N_2 and N). Temperatures rise with height, owing to the absorption of extreme ultraviolet radiation (0.125-0.205 μm) by molecular and atomic oxygen, probably approaching 800-1,200 K at 350 km, but these temperatures are essentially theoretical. For example, artificial satellites do not acquire such temperatures because of the rarefied air. 'Temperatures' in the upper thermosphere and exosphere undergo wide diurnal and seasonal variations. They are higher by day and are also higher during a sunspot maximum, although the changes are only represented in varying velocities of the sparse air molecules.

Above 100 km, the atmosphere is increasingly affected by cosmic radiation, solar X-rays and ultraviolet radiation, which cause ionization, or electrical charging, by separating negatively charged electrons from neutral oxygen atoms and nitrogen molecules, leaving the atom or molecule with a net positive charge (an ion). The Aurora Borealis and Aurora Australis are produced by the penetration of ionizing particles through the atmosphere from about 300 km to 80 km, particularly in zones about 10-20 ° latitude from the earth's magnetic poles. On occasion, however, the aurorae may appear at heights up to 1,000 km, demonstrating the immense extension of a rarefied atmosphere. The term ionosphere is commonly applied to the layers above 80 km.

5 Exosphere and magnetosphere

The base of the exosphere is between about 500 km and 750 km. Here atoms of oxygen, hydrogen and helium (about 1 per cent of which are ionized) form the tenuous atmosphere, and the gas laws cease to be valid. Neutral helium and hydrogen atoms, which have low atomic weights, can escape into space since the chance of molecular collisions deflecting them downwards becomes less with increasing height. Hydrogen is replaced by the breakdown of water vapour and methane (CH_4) near the mesopause, while helium is produced by the action of cosmic radiation on nitrogen and from the slow but steady breakdown of radioactive elements in the earth's crust.

Ionized particles increase in frequency through the exosphere and, beyond about 200 km, in the magnetosphere there are only electrons (negative) and protons (positive) derived from the solar wind - a plasma of electrically conducting gas.

Упражнение 2.

Ответьте на следующие вопросы:

1. Какой слой атмосферы является самым нижним?
2. Как в тропосфере температура изменяется с высотой?
3. Какую часть всей массы атмосферы включает тропосфера?
4. С чем связан максимум температуры в стратосфере?
5. Как меняется температура в стратосфере?
6. Какой слой атмосферы находиться над стратосферой?
7. К какому слою относится термин ионосфера?
8. На какой высоте располагается экзосфера?
9. Между какими частями атмосферы располагаются тропопауза, стратопауза и мезопауза?

Упражнение 3.

Найдите в тексте термины, соответствующие следующим выражениям.

prevail	for instant	result in	man-made
actually	be exposed	notable	rare
warming	probably	changes	
on the contrary	meanwhile	involve	

Упражнение 4.

Добавьте одно или более слов в каждую группу.

troposphere	low	divide
thermosphere	great	expand
exosphere	cool	remain

Упражнение 5.

Переведите следующие слова на русский язык.

throughout	roughly	since	beyond	mainly
thereby	often	still	fairly	thus
additionally	otherwise	while	generally	in turn

Упражнение 6.

Из слов в правой и левой колонке образуйте цепочки существительных:

rocket	transfer
temperature	regime
weather	inversion
heat	molecule
tropopause	flight
wind	atom
air	phenomena
helium	elevation

Упражнение 7.

Образуйте причастия 1 и 2 рода от следующих глаголов:
Come, consist, separate, occur, expend, remain, act, penetrate, warm.

Упражнение 8.

Прочитайте следующие выражения:
6.5º C/km, 12 months, 140 K, 60 mb, 0.125 μm.

Упражнение 9.

Вставьте в пропуски в тексте подходящие предлоги:
by, on ,of, for, to, in, from, about, by, over, due to.

Carbon dioxide

The major reservoirs … carbon are … limestone sediments and fossil fuels … land and … the world's oceans. The atmosphere contains … $750 \cdot 10^{12}$ kg … carbon, corresponding … a CO_2 concentration … 358 ppm. The major fluxes … atmospheric carbon dioxide are a result … solution/dissolution … the ocean and photosynthesis/respiration and decomposition … biota. The average time … CO_2 molecule to be dissolved … the ocean or taken up … plants is about four years. Photosynthetic activity leading … primary production … land involves $50 \cdot 10^{12}$ kg … carbon annually, representing 7 percent … atmospheric carbon; this accounts … the 14 ppm annual oscillation … CO_2 observed … the northern hemisphere …its extensive land biosphere.

Упражнение 11.

Переведите текст письменно. (Контрольное время – 45 минут)

Ozone layer reduction

Ozone (O_3) is distributed very unevenly with height and latitude as a result of the complex photochemistry involved in its production. Since the late 1970s, dramatic declines in springtime total ozone have been detected over high southern latitudes. The normal increase in stratospheric ozone associated with increasing solar radiation in spring apparently failed to develop. Observations in Antarctica show a decrease in total ozone in September-October from 320 Dobson units (10^{-3}cm at standard atmospheric temperature and pressure) in the 1960s to around 100 in the 1990s. The results from one specific location illustrate the presence of an 'ozone hole' over the south polar region. Similar reductions are also evident in the Arctic and at lower latitudes. Between 1979 and 1986, there was a 30 per cent decrease in ozone at 30–40 km altitude between latitudes 20 and 50 °N and S; along with this there has been an increase in ozone in the lowest 10 km as a result of anthropogenic activities. These changes in the vertical distribution of ozone concentration are likely to lead to changes in atmospheric heating, with implications for future climate trends. The global mean column total decreased from 306 Dobson units for 1964-80 to 297 for 1984-93. The decline over the last 25 years has exceeded 7 per cent in middle and high latitudes. The effects of reduced stratospheric ozone are particularly important for their potential biological damage to living cells and human skin. It is estimated that a 1 per cent reduction in total ozone will increase ultraviolet-B radiation by 2 per cent, for example, and ultraviolet radiation at 0.30 μm is a thousand times more damaging for the skin than at 0.33 μm. The ozone decrease would also be greater in higher latitudes. However, it should be noted that the mean latitudinal and altitudinal gradients of UV-B radiation imply that the effects of a 2 per cent UV-B increase in mid-latitudes could be offset by moving poleward 20 km or 100 m lower in altitude! Recent polar observations suggest more dramatic changes. Stratospheric ozone totals in 1990 over Palmer Station, Antarctica (65°S), were found to have maintained low levels from September until early December, instead of recovering in November. Hence, the altitude of the sun was higher and the incoming radiation much greater than in previous years, especially at wavelengths $\leq$0.30 μm. It remains, however, to determine the specific effects of increased UV radiation on marine biota, for instance.

Lesson 3

Упражнение 1.

Прочитайте и переведите текст.

The general circulation

The observed patterns of wind and pressure prompt consideration of the mechanisms maintaining the general circulation of the atmosphere – the large – scale patterns of wind and pressure that persist throughout the year or recur seasonally. Reference has already been made to one of the primary driving forces, the imbalance of radiation between lower and higher latitudes, but it is also important to appreciate the significance of energy transfers in the atmosphere. Energy is continually undergoing changes of form. Unequal heating of the earth and its atmosphere by solar radiation generates potential energy, some of which is converted into kinetic energy by the rising of warm air and the sinking of cold air. Ultimately, the kinetic energy of atmospheric motion on all scales is dissipated by friction end small-scale turbulent eddies (i.e. internal viscosity). In order to maintain the general circulation, the rate of generation of kinetic energy must obviously balance its rate of dissipation. These rates are estimated to be about 2 W m^{-2}, which amounts to only 1 per cent of the average global solar radiation absorbed at the surface and in the atmosphere. In other words, the atmosphere is a highly inefficient heat engine.

A second controlling factor is the angular momentum of the earth and its atmosphere. This is the tendency for the earth's atmosphere to move, with the earth, around the axis of rotation. Angular momentum is proportional to the rate of spin (that is the angular velocity) and the square of the distance of the air parcel from the axis of rotation. With a uniformly rotating earth and atmosphere, the total angular momentum must remain constant (in other words, there is a conservation of angular momentum). If, therefore, a large mass of air changes its position on the earth's surface such that its distance from the axis of rotation also changes, then its angular velocity must change in a manner so as to allow the angular momentum to remain constant. Naturally, absolute angular momentum is high at the equator and decreases with latitude to become zero at the poles (that is, the axis of rotation), so air moving polewards tends to acquire progressively higher eastward velocities.

For example, air travelling from 42 to 46° latitude and conserving its angular momentum would increase its speed relative to the earth's surface by 29 m s^{-1}. This is the same principle that causes an ice skater to spin more violently when her arms are progressively drawn into the body. In practice, this increase of air-mass velocity is countered or masked by the other forces affecting air movement (particularly friction), but there is no doubt that many of the important features of the general atmospheric circulation result from this poleward transfer of angular momentum.

The necessity for a poleward momentum transport is readily appreciated in terms of the maintenance of the mid-latitude westerlies. These winds continually impart westerly (eastward) relative momentum to the earth by friction, and it has been estimated that they would cease altogether due to this frictional dissipation of energy in little over a week if their momentum were not continually replenished from elsewhere. In low latitudes, the extensive tropical easterlies are gaining westerly relative momentum by friction as a result of the earth rotating in a direction opposite to their flow, and this excess is transferred polewards with the maximum poleward transport occurring, significantly, in the vicinity of the mean subtropical jet stream at about 250 mb at 30°N and 30°S.

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

energy, form, potential, kinetic, turbulent, circulation, generation, momentum, absolute, equator, progressively, principle, practice, mask, transport, tropical, subtropical.

Упражнение 3.

Заполните таблицу, образовав недостающие части речи.

v.	n.	adj.	adv.
extend	conservation	relative	continually progressively

Упражнение 4.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *The general circulation*:

1. driving force	a. тот же самый принцип
2. unequal heating	b. в течение недели
3. angular velocity	c. все вместе
4. jet stream	d. следовательно
5. large-scale	e. струйное течение
6. same principle	f. неравномерное нагревание
7. violently	g. в основном
8. altogether	h. угловая скорость
9. over a week	i. крупномасштабный
10. ultimately	j. управляющая сила
11. therefore	k. сильно

Упражнение 5.

Составьте 5 вопросов к первому абзацу текста *The general circulation.*

Упражнение 6.

(Парная работа) Ответьте на вопросы в упражнении 6.

Упражнение 7.

Найдите подлежащее в каждом предложении второго абзаца текста *The general circulation.*

Упражнение 8.

Вставьте соответствующий предлог и подберите определение к каждому глаголу*: about, down, off, into, up, in for.*

1. break …	a. начать
2. look …	b. распространяться
3. pick …	c. перестать
4. leave …	e сокращать
5. go …	f. исследовать
6. lead …	g. расщеплять
7. cut …	h. получать
8. get …	i. интересоваться

Упражнение 9. Прочитайте текст и найдите ответы на следующие вопросы. (Контрольное время – 7 минут):

1. От чего зависят изменения давления с высотой?
2. Какой тип центров действия атмосферы преобладает в субтропических, субполярных и экваториальных зонах?
3. Какие ветра преобладают в тропической и умеренной зоне?
4. Какой тип циркуляции называют ячейкой Уокера?

Circulations in the vertical and horizontal planes

The vertical change of pressure with height depends on the temperature structure. High-(low-) pressure systems intensify with altitude in a warm (cold) air column; thus warm lows and cold highs are shallow features. This 'thickness' relationship is illustrated by the upper-level subtropical anticyclones and polar vortex in both hemispheres. The intermediate mid-latitude westerly winds thus have a large 'thermal wind' component. They become concentrated into upper tropospheric jet streams above sharp thermal gradients, such as fronts. The upper flow displays a large-scale long-wave pattern, especially in the northern hemisphere, related to the influence of mountain barriers and land-sea differences. The surface pressure field is dominated by semi-permanent subtropical highs, subpolar lows and, in winter, shallow cold continental highs in Siberia and north-western Canada. The equatorial zone is predominantly low pressure. The associated global wind belts are the easterly trade winds and the mid-latitude westerlies. There are more variable polar easterlies and over land areas in summer a band of equatorial westerlies representing the monsoon systems. This mean zonal (west-east) circulation is intermittently interrupted by 'blocking' highs; an idealized sequence is known as the index cycle. The atmospheric general circulation, which transfers heat and momentum polewards, is predominantly in a vertical meridional plane in low latitudes (the Hadley cell), but there are also important east-west circulations (Walker cells) between the major regions of subsidence and convective activity. Heat and momentum exchanges in middle and high latitudes are accomplished by horizontal waves and eddies (cyclones/anticyclones). Substantial energy is also carried polewards by ocean current systems. Surface currents are mostly wind driven, but the slow deep ocean circulation (global conveyor belt) is due to thermohaline forcing.

Упражнение 10.

Найдите в каждом предложении текста *Circulations in the vertical and horizontal planes* подлежащее и сказуемое. Определите время и залог сказуемого.

Упражнение 11.

Письменно переведите текст. (Контрольное время – 30 минут)

The trade winds

The trades (or tropical easterlies) are important because of the great extent of their activity; they blow over nearly half the globe. They originate at low latitudes on the margins of the subtropical high-pressure cells, and their constancy of direction and speed (about 7 ms^{-1}) is remarkable. Trade winds, like the westerlies, are strongest during the winter half-year, which suggests they are both controlled by the same fundamental mechanism.

The two trade wind systems tend to converge in the Equatorial Trough (of low pressure). Over the oceans, particularly the central Pacific, the convergence of these air streams is often pronounced and in this sector the term Intertropical Convergence Zone (ITCZ) is applicable. Generally, however, the convergence is discontinuous in space and time. Equatorward of the main belts of the trades over the eastern Pacific and eastern Atlantic are regions of light, variable winds, known traditionally as the doldrums and much feared in past centuries by the crews of sailing ships. Their seasonal extent varies considerably: from July to September they spread westward into the central Pacific while in the Atlantic they extend to the coast of Brazil. A third major doldrum zone is located in the Indian Ocean and western Pacific. In March-April it stretches 16,000 km from East Africa to 180° longitude and it is again very extensive during October-December.

Блок 3
OCEAN STRUCTURE AND CIRCULATION

Lesson 1

Упражнение 1.

Прочитайте заголовок приводимого ниже текста. Подумайте, о чем в нем может идти речь. Приведите 10–15 слов, которые могут, с Вашей точки зрения, встретиться в тексте.

Прочитайте и переведите текст.

Ocean vertical structure

The oceans occupy 71 per cent of the earth's surface, with over 60 per cent of the global ocean area in the southern hemisphere. Three-quarters of the ocean area is between 3,000 and 6,000 m deep, whereas only 11 per cent of the land area exceeds 2,000 m altitude.

a Vertical

The major atmosphere-ocean interactive processes involve heat exchanges, evaporation, density changes and wind shear. The effect of these processes is to produce a major oceanic layering that is of great climatic significance:

1 At the ocean surface, winds produce a *thermally mixed surface layer* averaging a few tens of metres deep poleward of latitude 60°, 400 m at latitude 40° and 100-200 m at the equator.

2 Below the relatively warm mixed layer is the *thermocline*, a layer in which temperature decreases and density increases (the pycnocline) markedly with depth. The thermocline layer, within which stable stratification tends to inhibit vertical mixing, acts as a barrier between the warmer surface water and the colder deep-layer water. In the open ocean between latitudes of 60° north and south the thermocline layer extends from depths of about 200 m to a maximum of 1,000 m (at the equator from about 200 to 800 m; at 40° latitude from about 400 to about 1,100 m). Poleward of 60° latitude, the colder deep-layer water approaches the surface. Within the thermocline layer, the location of the steepest temperature gradient is termed the *permanent thermocline*, which has a dynamically inhibiting effect in the ocean similar to that of a major inversion in the atmosphere. However, heat exchanges take place between the oceans and the atmosphere by turbulent mixing

above the permanent thermocline, as well as by upwelling and downwelling involving deep-layer water. During spring and summer in the mid-latitudes, accentuated surface heating leads to the development of a *seasonal thermocline* occurring at depths of 50 to 100 m. Surface cooling and wind mixing tend to destroy this layer in autumn and winter.

3 Below the thermocline layer is a *deep layer* of cold, dense water. Within this, water movements are mainly driven by density variations, commonly due to salinity differences (i.e. having a *thermohaline* mechanism).

The ocean may be viewed as consisting of a large number of layers, the topmost subject to wind stress, the next layer down to frictional drag by the layer above, and so on; all layers being acted on by the Coriolis force. The surface water tends to be deflected to the right (in the northern hemisphere) by an angle averaging some 45 ° in the surface wind direction and to move at about 3 per cent of its velocity. This deflection increases with depth as the friction-driven velocity of the current decreases exponentially. On the equator, where there is no Coriolis force, the surface water moves in the same direction as the surface wind. This theoretical Ekman spiral was developed under assumptions of idealized ocean depth, wind constancy, uniform water viscosity and constant water pressure at a given depth. This is seldom the case in reality, and under most oceanic conditions the thickness of the wind-driven layer is about 100 to 200 m.

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

Hemisphere, thermocline, pycnocline, process, temperature, stratification, vertical, barrier, maximum, location, gradient, dynamically, upwelling, seasonal, exponentially, theory, spiral, idealize, constant, reality.

Упражнение 3.

Определите, к каким частям речи относятся следующие слова; напишите соответствующие английские сокращения для каждого из них (v., adv., n., adj., conj., part., prep., pron.):

Vertical, evaporation, as, with, which, within, colder, has, however, termed, occurring, mainly, thickness.

Упражнение 4.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний:

1. heat exchange	a. глубина океана
2. vertical mixing	b. движение воды
3. temperature gradient	c. направление ветра
4. water movement	d. поверхностный слой
5. density variation	e. температурный градиент
6. wind stress	f. теплообмен
7. wind direction	g. вертикальное перемешивание
8. ocean depth	h. изменения плотности
9. surface layer	i. ветровое воздействие

Упражнение 5.

Заполните, где это возможно, таблицу, вставив недостающие части речи.

v.	n.	adj.	adv.
produce	significance	stable	dynamically
extend	variation		relatively

Упражнение 6.

Прочитайте следующие выражения:

206 km; 1-2 m/day; 30°C; 1700; 1,367; 2.68931.

Упражнение 7.

Вставьте соответствующий предлог и подберите определение к каждому слову:*off about up away for down on out.*

1. pass …	a. выяснять
2. make …	b. продолжать
3. bring …	c. расширять
4. clear …	e. направляться
5. cut …	f. снимать
6. do	g. покидать
7. fall	h. вызывать
8. fill	i. сокращать

Упражнение 8.

Прочитайте текст и найдите в нем ответы на следующие вопросы:

1. Какова средняя скорость апвеллинга?
2. От чего она зависит?
3. Где расположен основной регион апвеллинга?

(Контрольное время – 7 минут)

Upwelling

In contrast with the currents on the west sides of the oceans, equatorward-flowing eastern currents acquire cyclonic vorticity, which is in opposition to the anticyclonic wind tendency, leading to relatively broad flows of low velocity. In addition, the deflection due to the Ekman effect causes the surface water to move westwards away from the coasts, leading to replacement by the upwelling of cold water from depths of 100–300 m. Average rates of upwelling are low (l-2m/day), being about the same as the offshore surface current velocities, with which they are balanced. The rate of upwelling therefore varies with the surface wind stress. As the latter is proportional to the square of the wind speed, small changes in wind velocity can lead to marked variations in rates of upwelling. Although the band of upwelling may be quite narrow (about 200 km wide for the Benguela Current), the Ekman effect spreads this cold water westwards. On the poleward margins of these cold-water coasts, the meridional swing of the wind belts imparts a strong seasonality to the upwelling, the California Current upwelling, being particularly well marked during the period March-July.

A major region of deep-water upwelling is along the west coast of South America, which is normally assisted by the offshore airflow associated with the large-scale convective Walker cell linking South-east Asia with the eastern South Pacific. Every 2–10 years or so this pressure difference is disturbed, producing an El Nino event with weakening trade winds and a pulse of warm surface water spreading eastwards over the South Pacific, raising average ocean-surface temperatures from about 24 to 30 °C. Coastal upwelting can also he caused by other less important mechanisms such as surface current divergence or the effect of the ocean bottom configuration.

Упражнение 9.

Выберите из текста *Upwelling* 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 10.

Переведите текст письменно. (Контрольное время – 30 минут)

El Nino

The ocean is a thin, spherical shell of fluid on a rotating sphere and, in addition to the waves seen on the ocean surface when the wind is blowing, there are other waves that have a large amplitude, not at the surface, but along the subsurface thermocline. Some are confined to the neighborhood of the equator where they travel exceptionally fast. Because of those waves, warm surface waters can be redistributed along the equator far more rapidly than is possible at higher latitudes, which is why large-scale changes in sea surface temperature patterns, associated with a horizontal redistribution of upper ocean water, occur more readily in the tropics than in higher latitudes. Such an occurrence that leads to high sea surface temperatures in the eastern tropical Pacific is known as El Nino. The interval between El Nino episodes, three years approximately, depends on the time it takes the waves to propagate across the basin and hence depends on the width of the Pacific.

EL Nino affects everyone, either directly because of its influence on climate and weather, or indirectly because of its influence on the global economy. The impact of this phenomenon can be: devastating floods in Ecuador and Peru, where a warming of the surface waters of the eastern tropical Pacific – the signature of El Nino – is associated with the disappearance of the usually abundant fish; disastrous droughts in the "maritime" continent of southeastern Asia and northern Australia; unusual weather patterns over North and South America; poor monsoons over India; and low rainfall over southeastern Africa.

Упражнение 11.

Составьте 5 общих вопросов к тексту *El Nino.*

Упражнение 12.

(Парная работа) Ответьте на вопросы, составленные в упражнении 11.

Lesson 2

Упражнение 1.

Подумайте и приведите 10–15 слов, которые могут встретиться в тексте.

Прочитайте и переведите текст.

Ocean circulation

(1) General

Comparisons between the structure and dynamics of the oceans and the atmosphere have long been made, particularly in respect of their behaviour above the permanent thermocline and below the tropopause – their two most significant stabilizing boundaries. Within these two zones, fluid-like circulations are maintained by meridional thermal energy gradients, dominantly directed polewards, and acted upon by the Coriolis force. Prior to the last quarter of a century, oceanography was studied in a coarsely averaged spatial-temporal framework similar to that applied in classical climatology. At the present day, however, its similarities with modern meteorology are more marked. The major behavioural differences between the oceans and the atmosphere derive from the greater density and viscosity of ocean waters and the much greater frictional constraints placed on their global movement. Macroscale characteristics of ocean dynamics that invite comparison with atmospheric features include the general circulation, major oceanic gyres (similar to atmospheric subtropical high-pressure cells), major jet-like streams such as sections of the Gulf Stream, large-scale areas of subsidence and uplift, the stabilizing layer of the permanent thermocline, boundary layer effects, frontal discontinuities created by temperature and density contrasts, and water mass ('mode water') regions. Mesoscale characteristics inviting atmospheric analogues are oceanic cyclonic and anticyclonic eddies, current meanders, cast-off ring vortices, jet filaments, and circulations produced by irregularities in the North Equatorial Current.

(2) Macroscale

The most obvious feature of the surface oceanic circulation is the control exercised over it by the low-level planetary wind circulation, especially by the subtropical oceanic high-pressure circulations and the

westerlies. The oceanic circulation also displays seasonal reversals of flow in the monsoonal regions of the northern Indian Ocean, off East Africa and off northern Australia. As water moves meridionally, the conservation of angular momentum implies changes in relative vorticity, with poleward-moving currents acquiring anticyclonic vorticity and equatorward-moving currents acquiring cyclonic vorticity.

The more or less symmetrical atmospheric subtropical high-pressure cells produce oceanic gyres with centres displaced towards the west sides of the oceans. The gyres in the southern hemisphere are more symmetrically located than those in the northern, due possibly to their connection with the powerful West Wind Drift. This results, for example, in the Brazil Current being not much stronger than the Benguela Current. The most powerful southern hemisphere current, the Agulhas, possesses nothing like the jet-like character of its northern counterparts.

Equatorward of the subtropical high-pressure cells, the persistent trade winds generate the broad North and South Equatorial Currents. On the western sides of the oceans, most of this water swings polewards with the airflow and thereafter increasingly comes under the influence of the Ekman deflection and of the anticyclonic vorticity effect. However, some water tends to pile up near the equator on the western sides of oceans, partly because here the Ekman effect is virtually absent, with little poleward deflection and no reverse current at depth. To this is added some of the water that is displaced northwards into the equatorial zone by the especially active subtropical high-pressure circulations of the southern hemisphere. This accumulated water flows back eastward down the hydraulic gradient as compensating narrow surface Equatorial Counter-Currents, unimpeded by the weak surface winds. Near the equator in the Pacific Ocean, upwelling raises the thermocline to only 50–100 m depth, and within this layer there exist thin, jet-like Equatorial Undercurrents flowing eastwards (under hydraulic gradients) at the considerable velocity of 1 to 1.5 m s^{-1}.

As the circulations swing polewards around the western margins of the oceanic subtropical high-pressure cells, there is the tendency for water to pile up against the continents, giving, for example, an appreciably higher sea level in the Gulf of Mexico than that along the Atlantic coast of the United States. This accumulated water cannot escape by

sinking because of its relatively high temperature and resulting vertical stability, and it consequently continues polewards in the dominant direction of surface airflow, augmented by the geostrophic force acting at right angles to the ocean surface slope. As a result of this movement, the current gains anticyclonic vorticity, which reinforces the similar tendency imparted by the winds, leading to relatively narrow currents of high velocity (for example, the Kuroshio, Brazil, Mozambique-Agulhas and, to a less-marked extent, the East Australian Current). In the North Atlantic, the configuration of the Caribbean Sea and Gulf of Mexico especially favours this pile-up of water, which is released polewards through the Florida Straits as the particularly narrow and fast Gulf Stream. These poleward currents are opposed both by their friction with the nearby continental margins and by energy losses due to turbulent diffusion, such as those accompanying the formation and cutting off of meanders in the Gulf Stream. These poleward western boundary currents (e.g. the Gulf Stream and the Kuroshio Current) are fast, deep and narrow (i.e. approximately 100 km wide and reaching surface velocities greater than 2 m s^{-1}), contrasting with the slower, wider and more diffuse eastern boundary currents such as the Canary and California (i.e. approximately 1,000 km wide with surface velocities generally less than 0.25 m s^{-1}). The northward-flowing Gulf Stream causes a heat flux of $1.2 \cdot 10^{15}$ W, 75 per cent of which is lost to the atmosphere and 25 per cent in heating the Greenland-Norwegian Seas area.

On the poleward sides of the subtropical high-pressure cells, westerly currents dominate, and where they are unimpeded by land masses in the southern hemisphere they form the broad and swift West Wind Drift. This strong current, driven by unimpeded winds, occurs within the zone 50 to 65°S and is associated with a southward-sloping ocean surface generating a geostrophic force, which intensifies the flow. Within the West Wind Drift, the action of the Coriolis force produces a convergence zone at about 50°S marked by westerly submarine jet streams reaching velocities of 0.5 to 1 m s^{-1}. In the northern hemisphere, a great deal of the eastward-moving current in the Atlantic swings northwards, leading to anomalously very high sea temperatures, and is compensated for by a southward flow of cold arctic water at depth. However, more than half of the water mass comprising the North Atlantic Current, and almost all that of the North Pacific Current,

swings south around the east sides of the subtropical high-pressure cells, forming the Canary and California Currents. Their southern-hemisphere equivalents are the Benguela, Humboldt or Peru, and West Australian Currents.

(3) Mesoscale

Mesoscale eddies and rings in the upper ocean are generated by a number of mechanisms, sometimes by atmospheric convergence or divergence or by the casting off of vortices by jet-like currents such as the Gulf Stream. These vortices are generated by the transfer of warm water from low to high latitudes. Oceanographic eddies occur on the scale of 50–400 km diameter and are analogous to atmospheric low- and high-pressure systems. Ocean mesoscale systems are much smaller than atmospheric depressions (which average about 1,000 km diameter), travel much slower (a few kilometres per day, compared with about 1,000 km per day for a depression) and persist from one to several months (compared with a depression life of about a week). Their maximum rotational velocities occur at a depth of about 150 m, but the vortex circulation may be felt to depths of several thousands of metres. Some eddies move parallel to the main flow direction, but many move irregularly equatorwards or polewards. In the North Atlantic, for example, this produces a 'synoptic-like' situation in which up to 50 per cent of the area may be occupied by mesoscale eddies. Cyclonic rings are commonly three times as numerous as anticyclonic eddies, having a maximum rotational velocity of about 1.5 m s^{-1}.

Упражнение 2.

Ответьте на следующие вопросы:

1. В чем причина основных различий в поведении между океаном и атмосферой?
2. Какие общие макро- и мезомасштабные детали характерны для циркуляции атмосферы и океана?
3. В чем заключается эффект Экмана?
4. Почему уровень моря в Мексиканском заливе выше, чем у Атлантического побережья США?
5. Какой наклон в южном полушарии имеет поверхность океана?

Упражнение 3.

Найдите в тексте термины, соответствующие следующим выражениям.

especially	apparent	because of	yet
like	show	own	close
originate	shift	wide	

Упражнение 4.

Словам в левой колонке подберите антонимы в правой колонке.

1. long	a. difference
2. below	b. weaker
3. similarity	c. raise
4. most	e stay
5. stronger	f. short
6. sink	g. deep
7. shallow	h. above
8. move	i. least

Упражнение 5.

Переведите следующие слова на русский язык.

however	for example	like	towards	between
such as	consequently	within	about	over
dominantly	some	almost	commonly	also

Упражнение 6.

Из слов в правой и левой колонке образуйте цепочки существительных:

ocean	layer
energy	mass
boundary	dynamics
density	meander
water	contrast
ring	gradient
trade	vortex
current	wind

Упражнение 7.

Образуйте причастия 1 и 2 рода из следующих глаголов. Найдите примеры таких причастий в тексте из упражнения 1.
Derive, invite, display, imply, produce, posses, generate, tend, raise.

Упражнение 8.

Прочитайте текст. (Контрольное время – 10 минут)

Deep ocean circulation

Whereas above the permanent thermocline the ocean circulation is mainly wind driven, the deep ocean circulation is powered by density gradients due to salinity and temperature differences. These differences are mostly produced by surface processes, which feed cold, saline water to the deep ocean basins in compensation for the deep water delivered to the surface by upwelling. Although upwelling occurs chiefly in narrow coastal locations, subsidence takes place largely in two broad ocean regions – the northern North Atlantic and the Antarctic Weddell Sea.

In the North Atlantic, particularly in winter, heating and evaporation produce warm, saline water which flows northwards both in the near-surface Gulf Stream-North Atlantic Current and at intermediate depths of around 800 m. In the Norwegian and Greenland Seas, its density is enhanced by further evaporation due to high winds, by the formation of sea ice, which expells brine during ice growth, and by cooling. Exposed to evaporation and to the chill high-latitude air masses, the surface water cools from about 10 to 2°C, releasing immense amounts of heat to the atmosphere, supplementing solar insolation there by some 25-30 per cent and heating Western Europe. The resulting dense high-latitude water, equivalent in volume to about twenty times the combined discharge of all the world's rivers, sinks to the bottom of the North Atlantic and fuels a southward-flowing density (thermohaline) current, which forms part of a global deep-water conveyor belt. This broad, slow and diffuse flow, occurring at depths of greater than 1,500 m, is augmented in the South Atlantic/circum-Antarctic/ Weddell Sea region by more cold, saline, dense subsiding water. The conveyor belt then flows eastwards under the Coriolis influence, turning north into the Indian and, especially, the Pacific Ocean. The time taken for

the conveyor belt circulation to move from the North Atlantic to the North Pacific has been estimated at 500-1,000 years. In the Pacific and Indian Oceans, a decrease of salinity due to water mixing causes the conveyor belt to rise and to form a less deep return flow to the Atlantic, the whole global circulation occupying some 1,500 years or so. An important aspect of this conveyor belt flow is that the western Pacific Ocean contains a deep source of warm summer water (29°C). This heat differential with the eastern Pacific assists the high phase Walker circulation.

The thermal significance of the conveyor belt implies that any change in it may promote climatic changes, which may be apparent at time scales of several hundred or thousand years. It has been suggested, however, that any impediment to the rise of deep conveyor belt water might cause ocean surface temperatures to drop by 6°C within 30 years at latitudes of 60°N. Changes to the conveyor belt circulation might be caused by lowering the salinity of the surface water of the North Atlantic by increased precipitation, ice melting, or fresh water inflow. However, the complex mechanisms and consequences of the deep ocean conveyor belt are still only imperfectly understood.

Упражнение 9.

Ответьте на следующие вопросы, исходя из информации в тексте:

1. Что является основными факторами, обусловливающими глубоководную циркуляцию в океане?
2. Каковы основные крупномасштабные особенности глубоководной циркуляции в океане?
3. Чем могут быть вызваны изменения в глубоководной циркуляции, и к каким последствиям они могут привести?

Упражнение 10.

Выпишите 10 ключевых слов из текста в упражнении 8.

Упражнение 11.

Письменно переведите текст. (Контрольное время – 30 минут)

The Southern Oscillation

The locations of the furnaces, the convective zones of rising air and low surface pressures, are determined by temperature patterns at Earth's surface. The air ascends where surface temperatures have maxima. The seasonal north-south migrations of the convective zones therefore tend to keep those zones in the summer hemisphere. Over Africa and South America the zones of heavy rainfall are difficult to dislodge from the continents because surface temperatures can attain higher values on land than over the oceans. The maritime continent of southeastern Asia is an entirely different matter because its eastern boundary coincides with that of the pool of warm water that covers the western tropical Pacific. Should this pool expand eastward, so would the region of rising air and heavy rainfall, which is exactly what happens interannually during El Nino. On such occasions, the eastern tropical Pacific experiences an increase in sea surface temperatures and in rainfall, a decrease in surface pressure, and a relaxation of the trade winds. Because of this eastward shift, the tropical regions west of the date line, including India and southeastern Africa, experience decreases in rainfall.

In the same way that the seasonal cycle is an oscillation between winter and summer, so the Southern Oscillation is a fluctuation between El Nino and a complementary state, which has been given the opposite name La Nina. Whereas the seasonal cycle is forced by regular variations in the intensity of sunlight, the Southern Oscillation corresponds to a natural mode of oscillation of the coupled ocean and atmosphere and is literally the music of our spheres (the atmosphere and hydrosphere).

Блок 4
WATER RESOURCES

Lesson 1

Упражнение 1.
Прочитайте и переведите следующий текст.

Water – facts and figures

Hydrology is a science dealing with the waters of the earth, their occurrence, distribution and circulation, their chemical and physical properties and their interaction with the environment. In this context, water is viewed in the same way as soil, vegetation, climate or rock, as an element of the landscape to be investigated and ultimately understood by means of rigorous scientific quantification and analysis. Water, the subject of hydrology, is both commonplace and unique. It is found everywhere in the earth's ecosystem and taken for granted in much of the developed world. It is, however, the only naturally occurring inorganic liquid and is the only chemical compound that occurs in normal conditions as a solid, a liquid and a gas. Its distribution over the globe is amazingly uneven.

Water plays a fundamental part in the distribution of chemicals through its central role in many chemical reactions, the transport of dissolved chemicals and the erosion and deposition of sediments. Its gaseous form, water vapour, is the principal greenhouse gas in the earth's atmosphere, an order of magnitude greater than CO_2, which is the second most important greenhouse gas.

About 97% occurs as saline water in the seas and oceans. Only the remaining 3% is fresh water and of this, considerably more than one half is locked up in ice sheets and glaciers and another substantial volume occurs as virtually immobile deep groundwater. The really mobile fresh water, which contributes frequently and actively to rainfall, evaporation and streamflow, thus represents only about 0.3% of the global total. These estimated values of global water storage must be treated with caution because of the difficulties of monitoring and exact quantification at the macroscale. For example, the volumes of the ocean basins and of the major ice sheets depend upon sea bed and sub-ice topography which have only recently been mapped with reasonable accuracy.

Reserves of deep groundwater are difficult to assess and estimates are periodically revised, usually upwards, like those of fossil fuels. Shallow groundwater storage is more accessible and mostly easier to estimate, although the proportion of usable non-saline water is still far from certain. Atmospheric water vapour content is normally monitored either by radio-sonde balloons released daily from just 1500 global locations or from ultra-red spectrometers in weather satellites. Unfortunately, due to the presence of clouds, IR spectrometry is more difficult to interpret for the air layers closest to the earth's surface, where water vapour values are the highest.

In the past, hydrologists focused their attention on the relatively small amount of fresh water occurring either as rivers, lakes, soil water and shallow groundwater, or in the vegetation cover and the atmosphere. Increasingly, however, it is recognized that the oceans play a dominant role in the global water and energy budgets and that large-scale perturbations of the hydrological system may result from changes in sea surface temperature, such as those associated with El Nino, or from modifications of the thermo-haline ocean circulation which may result from the increasingly rapid break-up of major ice sheets in both the northern and southern hemispheres. It is also important to recognize that the small volume of mobile fresh water is itself distributed unevenly in both space and time. Wetland and prairie, forest and scrub, snowfield and desert, each exhibits different regimes of precipitation, evaporation and streamflow, each offers different challenges of understanding for the hydrologist and of water management for the planner and engineer, and each poses different benefits and threats to human life and livelihood as between the developed and the developing world.

Упражнение 2.

Ответьте на вопросы:

1. What does hydrology deal with?
2. Where is water found on the planet?
3. What is unique about water as a chemical compound?
4. What is the principal greenhouse gas on the earth?
5. How much saline and fresh water is there on our planet?
6. Why should global water storage values be treated carefully?
7. What has been mapped only recently?
8. Which water reserves are easier to be estimated? Which are more difficult?

9. How is water vapour content monitored?
10. What water did hydrologists study in the past?
11. What plays the main role in the global water and energy budgets?
12. How unevenly is water distributed?

Упражнение 3.

Соедините слова в колонках А и В.

A.	B.
sea	fuel
ice	gas
water	flow
stream	water
greenhouse	management
ocean	bed
water	sheet
earth's	storage
fossil	surface
soil	basin

Упражнение 4.

Переведите следующие выражения на английский язык:
Посредством (при помощи), оставшийся, неравномерный, относительно, принимать как должное, быстрый, зависеть от, или…или.., как... так и..., из-за (2), однако, хотя, все еще, между, следовательно (2), близко, в основном, к сожалению, значительно, тот же самый, свойство, встречаться, представлять, оценка (2).

Упражнение 5.

Образуйте причастия 1 и 2 рода из следующих глаголов. Найдите примеры таких причастий в тексте из упражнения 1.
Estimate, develop, investigate, depend, remain, grant, understand, show, focus, recognize, associate, use, occur, find.

Упражнение 6.

Образуйте наречия из следующих слов:
Increase, consider, main, substantial, day, period, frequent, globe, ultimate, nature, science, amaze, virtual, large.

Упражнение 7.

Образуйте соответствующие части речи из приведенных в скобках слов:

Glaciers store water over (relate) long timescales compared to rivers and lakes -hundreds to a few thousands of years. Ice sheets store water for even (long) - ten thousands of years. But the shorter glacier timescales are (compare) to human timescales, so people notice how glaciers change, and these changes have obvious impacts on the human environment. Many river systems depend on glacier melt, which (maintain) the water supply through the summer. As glaciers shrink, so does the (freeze) water supply they store. This is one of the reasons why it is important to measure how and understand why glaciers change over time.

Glacier meltwater (event) makes its way to the ocean, where it can affect global sea level. As terrestrial ice masses grow, sea level (fall); and as masses shrink, sea level (rise). At the last glacial maximum, about 18,000 years ago, the growth of ice sheets and glaciers (cause) sea level to lower by about 120 meters. Most of that change (be) due to the formation of large ice sheets in northern North America and Europe, but mountain glaciers, too, had their role.

Упражнение 8.

Поставьте глаголы в скобках в форму страдательного залога:

Approximately 97% of the fresh water available in the world is underground. Wells provide groundwater for individual domestic needs, communities, cities, industry, crop irrigation and agriculture. Some wells tap hot water, or geothermal resources. In other cases, groundwater (use) solely for its cooling capabilities. Some wells (dig) just to study water quality or quantity: these (call) monitoring or observation wells.

Regardless of its purpose, a well (define) as an artificial hole in a land surface created to access a liquid. It normally has a small diameter, typically less than 3 meters and usually (measure) in centimeters. Wells may (construct) to seek water, oil or natural gas.

Упражнение 9.

Составьте вопросы к тексту из упражнения 8.

1. Where/ fresh water/ available?
2. What/ groundwater/ provided/ for?
3. Wells/ tap/ solely/ cold water?

4. What kind of wells/ dug/study/water quality or quantity?
5. How/ a well/ defined?
6. How big/ its diameter?
7. Why/ wells/ constructed?

Упражнение 10.

В приведенном ниже тексте используйте следующие слова: *can, providing, however, satellites, due to, cooling, atmospheric, causes, boarded, observers.*

Snow and ice account for just over 75% of the Earth's freshwater, although most of this is held as ice in Antarctica and Greenland, with a residence time of the order of 10, 000 years. Snow has a great hydrological importance. It has a … effect on climate by increasing the albedo and modifying the surface radiation balance and the near-surface air temperature, and it … a great amount of energy to be expended on melting. Seasonal snow cover changes are known to affect global … circulation, and may have an important role influencing climatic change. In arid and semi-arid areas … by high mountains, including the semi-arid western United States, northern India and Iran, snowmelt is an important seasonal source of water. The presence of snow on the ground is important … disruption of travel and commerce, and seasonal flood risk may be increased by snowmelt. In addition to … a store of water, snow cover can serve as protective insulation for soil and crops through the winter. Information on the spatial distribution of snow was traditionally based on reports from … at meteorological stations. But it is difficult to gain a broad picture of the areal extent of snow cover from such local observations. Due to its high albedo, snow cover can be readily distinguished from snow-free ground using visible radiation reflectance. Remote sensing from aircraft or … enables the rapid mapping of the extent of snow cover over large areas. It is ,…, often difficult to distinguish snow from cloud cover using visible reflectance alone, without repeated photography over time to filter out the variable cloud pattern. This … be overcome by the use of "passive" microwave radiation emitted naturally by the Earth's surface. This can penetrate cloud cover and allow the mapping of snow extent unobstructed by weather effects. However, passive microwave data have a low spatial resolution of several tens of kilometers.

Lesson 2

Упражнение 1.

Прочитайте слова и словосочетания и попробуйте догадаться, о чем пойдет речь в следующем тексте:

Water supply, fresh water, human use, usable supply, natural purification, groundwater, surface water, precipitation, runoff.

Упражнение 2.

Прочитайте и переведите текст.

Supply, renewal and use of water resources

Worldwide Supply and Renewal. The world's fixed supply of water in all forms (vapor, liquid, and solid) is enormous. If we could distribute it equally, there would be enough to provide every person on earth with 292 trillion liters (77 trillion gallons). However, only about 0.003% of the world's water supply is available as fresh water for human use, and this supply is unevenly distributed.

About 97% of the earth's total supply of water is found in the oceans and is too salty for drinking, growing crops, and most industrial purposes except cooling. The remaining 3% is fresh water, but over three-fourths of it is unavailable for use by plants, human beings, and other animals, because it lies too far under the earth's surface or is locked up in glaciers, polar ice caps, atmosphere, and soil. This leaves 0.5% of the earth's water available as fresh water in rivers, lakes, and economically recoverable underground deposits (groundwater) to a depth of 1,000 meters (1.6 miles). However, when we subtract the portion of this water that is highly polluted or too difficult and expensive to tap, the remaining supply amounts to about 0.003% of the world's water. To put this in measurements that we can comprehend, if the world's water supply were only 100 liters (26 gallons), our usable supply of fresh water would be only about 0.003 liter (one-half teaspoon).

That tiny fraction of usable fresh water still amounts to an average of 879,000 liters (232,000 gallons) for each person on earth. The supply is continually collected, purified, and distributed in the natural hydrologic (water) cycle. This natural purification process works as long as we don't pollute water faster than it is replenished or add chemicals that cannot be broken down by bacterial action.

Surface-Water Runoff. The fresh water we use comes from two sources: groundwater and surface-water runoff. Precipitation that does not infiltrate into the ground or return to the atmosphere is known as surface water and becomes runoff – water that flows into nearby streams, rivers, lakes, wetlands, and reservoirs. This flow of water is renewed fairly rapidly (12 to 20 days) in areas with average precipitation. The land area that delivers runoff, sediment, and water-soluble substances to a major river and its tributaries is called a watershed or drainage basin. Surface water can be withdrawn from streams, rivers, lakes, and reservoirs for human activities, but only part of the total annual runoff is available for use. Some flows in rivers to the sea too rapidly to be captured, and some must be left in streams for wildlife and to supply downstream areas. In some years the amount of runoff is reduced by drought.

Упражнение 3.

(Парная работа) Выберите из текста *Supply, renewal and use of water resources* 10–15 ключевых слов. Определите, к какой части речи они относятся.

Упражнение 4.

(Парная работа) Передайте содержание Surface Water Runoff в 5 предложениях.

Упражнение 5.

Вставьте предлоги*: at, in, for, to, of, with*.

1. Although they have normal motor activities, people suffering from somnambulism are not aware … their surroundings.
2. Contrary to what most people think, musicians are not particularly good … languages.
3. The virus responsible … Ebola fever comes from animal sources.
4. What he told the police is incompatible … the facts.
5. Satellite images are capable … detecting objects less than 15 cm across.
6. One of the effects of aspirin is to make patients less liable … heart attack and thrombosis.
7. They want to recruit a doctor who is qualified … tropical diseases.
8. Five research students were involved … industrial espionage.

Упражнение 6. Прочитайте текст и найдите ответы на следующие вопросы. (Контрольное время – 15 минут):

1. Что происходит с частью осадков?
2. Где накапливается вода?
3. Благодаря какому процессу теряется большая часть воды?
4. Благодаря какому процессу вода просачивается вглубь земли?
5. Что такое водоносный слой?
6. Благодаря чему пополняется водоносный слой?
7. Что такое водное зеркало?

Groundwater

Some precipitation seeps into the ground. Some of this infiltrating water accumulates as soil moisture and partially fills pores between soil particles and rocks within the upper soil and rock layers of the earth's crust. Most of this water is eventually lost to the atmosphere by evaporation from the upper layers of soil and by evapotranspiration from leaves.

Under the influence of gravity, some infiltrating water slowly percolates through porous materials deeper into the earth and completely saturates pores and fractures in spongelike or permeable layers of sand, gravel, and porous rock such as sandstone. These water-bearing layers of the earth's crust are called aquifers, and the water in them is known as groundwater. Aquifers are recharged or replenished naturally by precipitation, which percolates downward through soil and rock in what is called a recharge area. The recharge process is usually quite slow (decades to hundreds of years) compared to the rapid replenishment of surface water supplies. If the withdrawal rate of an aquifer exceeds its recharge rate, the aquifer is converted from a slowly renewable resource to a nonrenewable resource on a human time scale.

There are two types of aquifers: confined and unconfined. An unconfined, or water-table, aquifer forms when groundwater collects above a layer of relatively impermeable rock or compacted clay. The top of the water-saturated portion of an unconfined aquifer is called the water table. Thus groundwater is that part of underground water below the water table, and soil moisture is that part of underground water above the water table. Shallow, unconfined aquifers are recharged by water percolating downward from soils and materials directly above the aquifer.

To obtain water from an unconfined aquifer, a water table well must be drilled below the water table and into the unconfined aquifer. Because this water is under atmospheric pressure, a pump must be used to bring it to the surface. The elevation of the water table in a particular area rises during prolonged wet periods and falls during prolonged drought. The water table can also fall when water is pumped out by wells faster than the natural rate of recharge, creating a vacated volume known as a cone of depression.

A confined, or artesian, aquifer forms when groundwater is sandwiched between two layers of relatively impermeable rock, such as clay or shale. This type of aquifer is completely saturated with water under a pressure greater than that of the atmosphere. In some cases the pressure is so great that when a well is drilled into the confined aquifer, water is pushed to the surface without the use of a pump. Such a well is called a flowing artesian well. With other confined-aquifer wells, known as nonflowing artesian wells, pumps must be used, because pressure is insufficient to force the water to the surface. Confined aquifers cannot be recharged from directly above them; they receive water from areas without overlying impermeable rock layers. Thus recharge areas for confined aquifers can be hundreds of kilometers away from wells where water is withdrawn, and the rate of natural recharge is not governed by local precipitation at the point of withdrawal as it is for unconfined aquifers.

Упражнение 7.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *Groundwater*:

1. to seep	a. грунтовая вода
2. to accumulate	b. просачиваться
3. upper layers	c. водоносный слой
4. permeable layer	d. водное зеркало
5. water-bearing layer	e. область пополнения
6. groundwater	f. верхние слои
7. recharge area	g. проницаемый слой
8. water-table	h. неограниченный водоносный горизонт
9. unconfined aquifer	i. запас воды
10. water supply	j накапливаться

Упражнение 8.

Составьте план пересказа текста *Groundwater*.

Упражнение 9.

(Парная работа) Перескажите содержание текста *Groundwater* в 10 предложениях.

Упражнение 10.

Переведите текст письменно. (Контрольное время – 15 минут)

Water is our most abundant resource, covering about 71% of the earth's surface. This precious film of water – about 97% salt water and the remainder fresh – helps maintain the earth's climate and dilutes environmental pollutants. Essential to all life, water constitutes from 50% to 97% of the weight of all plants and animals and about 70% of your body. Water is also essential to agriculture, manufacturing, transportation, and countless other human activities.

Because of differences in average annual precipitation, some areas of the world have too little fresh water and others too much. With varying degrees of success, human beings have corrected these imbalances by capturing fresh water in reservoirs behind dams, transferring fresh water in rivers and streams from one area to another, tapping underground supplies, and attempting to reduce water use, waste, and contamination.

Упражнение 11.

Составьте 5 общих вопросов к тексту из упражнения 10.

Упражнение 12.

(Парная работа) Ответьте на вопросы, составленные в упражнении 11.

Lesson 3

Упражнение 1.

Ниже приводятся первые предложения первых 4-х абзацев текста. Какие выводы Вы можете сделать о содержании текста?

A number of experts consider the availability of adequate supplies of fresh water to be the most serious long-range problem confronting the world.

In many LDCs, poor people must spend a good part of their working hours fetching water.

Although reduced average annual precipitation usually triggers a drought, rapid population growth and poor land use intensify its effects.

Other countries get enough precipitation on an annual basis but receive most of it at one time of the year.

Упражнение 2.

Прочитайте и переведите текст. Проверьте правильность Ваших предположений.

Water resource problems

Too Little Water. A number of experts consider the availability of adequate supplies of fresh water to be the most serious long-range problem confronting the world. At least 80 arid and semiarid countries, accounting for nearly 40% of the world's population, now experience serious periodic droughts and have considerable difficulty growing enough food to support their populations. Most of these countries are in Asia and Africa. During the 1970s, major drought disasters affected an average of 24.4 million people and killed over 23,000 a year – a trend continuing in the 1980s. By 1985 more than 154 million people in 21 tropical and subtropical countries in Africa were on the brink of starvation because of the combined effects of rapid population growth, prolonged drought, land misuse, war, and ineffective government policies for water and soil resource management and agricultural development.

In many LDCs, poor people must spend a good part of their waking hours fetching water, often from polluted streams and rivers. To get water, many women and children in LDCs walk 16 to 25 kilometers (10 to 15 miles) a day, carrying heavy water-filled jars on their return trip.

Although reduced average annual precipitation usually triggers a drought, rapid population growth and poor land use intensify its effects. In many LDCs, large numbers of poor people have no choice but to try to survive on drought-prone land by cutting trees, growing crops at higher, more erosion-prone elevations, cultivating poor soils, and allowing their livestock to overgraze grasslands. The resulting land degradation contributes to the severity of long-term drought by reducing the amount of rainfall absorbed and slowly released by vegetation and soils. In many cases, the result is desertification.

Too Much Water. Other countries get enough precipitation on an annual basis but receive most of it at one time of the year. In India, for example, 90% percent of the annual precipitation falls between June and September – the monsoon season. This downpour runs off so rapidly that most of it cannot be captured and used. The massive runoff also leads to periodic flooding.

During the 1970s, major flood disasters affected 15.4 million people, killed an average of 4,700 people a year, and caused tens of billions of dollars in property damages – a trend that continued in the 1980s. Although floods are classified as natural disasters, human beings have contributed to the sharp rise in flood deaths and damages since the 1960s by removing water-absorbing vegetation and soil through cultivation of marginal lands, deforestation, overgrazing, and mining. Urbanization also increases flooding, even with moderate rainfall, by replacing vegetation with highways, parking lots, shopping centers, office buildings, homes, and numerous other structures.

Death tolls and damages from flooding have also increased because many poor people in LDCs have little choice but to live on land subject to severe periodic flooding and because many people in LDCs believe that the benefits of living in flood-prone areas outweigh the risks. Many urban areas and croplands in LDCs and MDCs are situated on floodplains – flat areas along rivers subject to periodic flooding – and coastlands because these sites are level, have highly fertile topsoil deposited by rivers, are close to supplies of surface water and water transportation routes, and provide recreational opportunities.

Since 1925 the U.S. Army Corps of Engineers, the Soil Conservation Service, and the Bureau of Reclamation have spent more than $8 billion on flood-control projects such as straightening stream channels

(channelization), dredging streams, and building dams, reservoirs, levees, and seawalls. Despite these efforts – and because these projects stimulate development on flood-prone land – property damage from floods in the United States has increased from about half a billion dollars a year in the 1960s to an average of about $3 billion a year in the 1980s.

A number of effective methods exist for preventing or reducing flood damage: replanting vegetation in disturbed areas to reduce runoff, building ponds in urban areas to retain rainwater and release it slowly to rivers, and diverting rainwater through storm sewers to holding tanks and ponds for use by industry. Floodplains should also be clearly identified, and laws or zoning regulations should be used to discourage their use for certain types of development. Sellers of property in these areas should be required to provide prospective buyers with information about average flood frequency.

Упражнение 3.

Определите подлежащее и сказуемое в каждом предложении первого абзаца текста *Water resource problems*.

Упражнение 4.

Найдите в тексте примеры этих частей речи.

v.	n.	adj.	adv.	prep.

Упражнение 5.

Вставьте в предложения: *despite the fact, namely, obviously, actually, yet, hence, thereby*.

1. Symptoms such as pain, fever, and vomiting are not diseases. … they are defense mechanisms.
2. "Psychotic" means that a patient has lost touch with reality, … "neurotic" refers to a less serious state.
3. People have always recognized the waste, brutality, and inhumanity of war, … it goes on.
4. The mesosphere is important … that it contains only about 0.1 per cent of the total mass of the atmosphere.
5. As a rule, aquatic reptiles use the same means of propulsion as fish and whales, … they use powerful beats of the tail.

6. The heat increases, … the entropy increases.
7. Cells and antibodies may co-operate, … destroying invading bacteria.
8. For a person who weighs less, the concentration of alcohol will … be proportionally higher.

Упражнение 6.

Прочитайте следующие слова и определите их соответствия в русском языке:

Periodic, experts, population, tropical, combined, agricultural, vegetation, massive, percent, season, cultivation, center, transportation, recreational.

Упражнение 7.

Прочитайте текст. (Контрольное время – 5 минут)

The U.S. Situation

Overall, the United States has plenty of fresh water, but much of its annual runoff is not in the desired place, occurs at the wrong time, or is contaminated from agricultural and industrial activities. Most of the eastern half of the country usually has ample average annual precipitation, while much of the western half has too little. Many major urban centers in the United States are located in areas that already have inadequate water or are projected to have water shortages.

In the eastern half of the United States, where there is usually no shortage of water, the major problems are flooding, inability to supply enough water to some large urban areas, and increasing pollution of rivers, lakes, and groundwater. For example, 3 million residents of Long Island, New York, must draw all their water from an underground aquifer that is becoming severely contaminated by industrial wastes, leaking septic tanks and landfills, and salt water from the ocean, which is drawn into the aquifer when fresh water is withdrawn.

The major water problem in arid and semiarid areas in the western half of the country is a shortage of runoff due to low average precipitation, high rates of evaporation, prolonged periodic drought, and rapidly declining water tables as farmers and cities deplete groundwater aquifers faster than they are recharged. Present water shortages and conflicts over water supplies will get much worse if more industries and

people migrate west as projected and compete with farmers for scarce water.

Упражнение 8.

Выберите из текста в упражнении 7 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 9.

Составьте 5 альтернативных вопросов к тексту из упражнения 7.

Упражнение 10.

(Парная работа) Ответьте на вопросы, составленные в упражнении 8

Упражнение 11.

Переведите текст письменно. (Контрольное время – 30 минут)

Desertification: a serious and growing problem

The conversion of rangeland (uncultivated land used for animal grazing), rain-fed cropland, or irrigated cropland to desertlike land with a drop in agricultural productivity of 10% or more is called desertification. Moderate desertification causes a 10% to 25% drop in productivity; severe desertification causes a 25% to 50% drop; and very severe desertification causes a drop of 50% or more and usually the formation of massive gullies and sand dunes.

Prolonged drought and hot temperatures may accelerate the desertification process. But its basic causes are overgrazing of rangeland by concentrating too many livestock on too little land area; improper soil and water resource management that leads to increased erosion, salinization, waterlogging, cultivation of marginal land with unsuitable terrain or soils, and deforestation and strip mining without adequate replanting.

Each year, the amount of desertified land grows by at least 20 million hectares (49 million acres) – an area equal to that of South Dakota. According to the UN Environmental Programme, one-fifth of the world's people now live in areas that may become desertified over the next 20 years.

The spread of desertification can be halted or sharply reduced by improved management of rangeland, forest, soil, and water resources, and much currently desertified land can be reclaimed. The total cost of such prevention and rehabilitation would be about $141 billion. Although this amount may seem staggering, it is only five and one-half times the estimated $26 billion annual loss in agricultural productivity from desertified land. Thus once this potential productivity is restored, the costs of the program could be recouped in five to ten years. However, funds now devoted to preventing desertification and restoring desertified lands fall far short of the need.

Упражнение 12.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *Desertification: a serious and growing problem*:

1. rangeland	a. слишком много
2. animal grazing	b. орошаемая земля
3. irrigated cropland	c. длительная засуха
4. massive gullies	d. заболачивание
5. prolonged drought	e. слишком мало
6. desertification process	f. малоплодородная земля
7. waterlogging	g. массивные овраги
8. marginal land	h. пастбище
9. too many	i. процесс опустынивания
10. too little	j. выпас животных

Блок 5
CLIMATE CHANGE

Lesson 1

Упражнение 1.

Прочитайте заголовок приводимого ниже текста. Подумайте, о чем в нем может идти речь. Приведите 10–15 слов, которые могут, с Вашей точки зрения, встретиться в тексте.

Прочитайте и переведите текст.

Climate forcing and feedbacks

The average state of the climate system is controlled by a combination of forcings external to the system (solar variability, astronomical effects, tectonic processes and volcanic eruptions), internal radiative forcings (atmospheric composition, cloud cover), anthropogenically induced changes (in atmospheric composition, surface land cover) and feedback effects (such as changes in atmospheric water vapour content or cloudiness caused by global temperature changes). It is useful to try and assess the magnitude of such effects, globally and regionally, and the time scales over which they operate.

1 **External forcing**

Solar variability. The sun is a variable star, and it is known that early in the earth's history (during the Archean three billion years ago) solar irradiance was about 80 per cent of the modern value. Paradoxically, however, the effect of this 'faint early sun' was offset, most likely, by a concentration of carbon dioxide that was perhaps 100 times higher than now, but also perhaps by the effects of a largely water-covered earth. The approximately 11-year solar cycle (and 22-year magnetic field cycle) is well known. Intervals when sunspot and solar flare activity were much reduced (especially the Maunder minimum of AD 1650–1700) may have caused cumulative effects leading to temperature decreases of about 1°C.

Tectonic processes. On geological time scales, there have been great changes in continental positions and sizes and in the configuration of ocean basins as a result of crustal processes (known as plate tectonics). These movements have also altered the size and location of mountain ranges and plateaus. As a result, the global circulation of the atmosphere and the pattern of ocean circulation and surface currents

have also been modified. Changes in continental location have contributed substantially to major ice age episodes (such as the Permo-Carboniferous glaciation of Gondwanaland) as well as to intervals with extensive arid (Permo-Triassic) or humid (coal deposits) environments during other geological periods. Over approximately the last few million years, the uplift of the Tibetan Plateau and the Himalayan ranges has caused the onset, or intensification, of desert conditions in western China and Central Asia.

Astronomical periodicities. The earth's orbit around the sun is subject to long-term variations. There are three principal effects on incoming solar radiation: the eccentricity (or stretch) of the orbit, with a period of approximately 95,000 years and 410,000 years; the tilt of the earth's axis (an approximately 41,000-year period); and a wobble in the earth's axis of rotation, which causes changes in the timing of perihelion. This precessional effect has a period of about 21,000 years.

Volcanic eruptions. Major explosive eruptions inject dust and sulphur dioxide aerosols into the stratosphere, where they may circle the earth for several years causing brilliant sunsets. Equatorial eruption plumes spread into both hemispheres, whereas plumes from eruptions in mid to high latitudes are confined to that hemisphere. Records of such eruptions are preserved in the Antarctic and Greenland ice sheets for at least the last 150,000 years. Observational evidence from the last 100 years demonstrates that major eruptions cause a hemisphere/global cooling of 0.5-1.0°C in the year following the event.

Atmospheric composition. There is a large 'natural' greenhouse, as a result of the atmospheric composition, distinct from human-induced changes over the last few centuries. Glacial-interglacial changes in terrestrial vegetation and in the oceanic uptake of trace gases, as a result of changes in the thermohaline circulation of the global ocean, have caused major fluctuations in atmospheric carbon dioxide (±50 ppm) and methane (±150 ppb). Negative (positive) excursions are associated with cold (warm) intervals. The changes in greenhouse gases (CO_2 and CH_4) and global temperatures are virtually coincident during both glacial and interglacial transitions, so that there is no clear causative agent. Both the long- term and rapid changes in atmospheric CO_2 seen in polar ice cores seem to result from the combined effects of ocean and land biological activity and ocean circulation shifts.

Rates of change. Obviously, changes in climate resulting from changes in the earth's geography through geological processes (e.g. position and size of ocean basins, continents and mountain ranges) are only perceptible on time scales of millions of years. Although geographical changes have had immense paleoclimatic significance, they are of less immediate concern to contemporary climatologists than the radiative forcing agents. Radiative forcing agents affect the supply and disposition of solar radiation. Solar radiation changes, like the non-radiative forcing agents, are external inputs into the atmosphere-earth-ocean-ice system but occur at a range of time scales from tens to hundreds of thousands and, probably, millions of years. Thus solar radiation is both a long-term and a short-term external forcing agent. Astronomical forcings give rise to global temperature fluctuations of ±2–5°C per 10,000 years. The timing of orbital forcing is also clearly represented in glacial-inter-glacial fluctuations with major glacial cycles spanning about 100,000 years (or 100 Ka). However, the most striking fact to emerge from analysis of two recent deep ice cores in central Greenland is the great rapidity of large changes in atmospheric temperature, precipitation and aerosol levels, presumably as a result of major readjustments of atmospheric circulation. The onset and termination of the Younger Dryas cold episode 12,900-11,600 BP (before present), with a switch from glacial to interglacial conditions and back again, apparently occurred within a five-year time interval for both transitions!

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

Combination, astronomical, volcanic, history, paradoxically, concentration, activity, minimum, position, configuration, episode, interval, period, rotation, aerosol, brilliant, demonstrate, result, negative, virtually.

Упражнение 3.

Найдите в тексте *Climate forcing and feedbacks* слова с суффиксами *~tion, ~ment, ~ty, ~ness, ~ance, ~ence, ~sion*. Определите, какой частью речи они являются и что означают.

Упражнение 4.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний:

1. water vapour content	a. климатическая система
2. cloud cover	b. ледниковый период
3. time scale	c. угольные отложения
4. mountain range	d. поверхностное течение
5. surface current	e. содержание водяного пара
6. ice age	f. пустынные условия
7. coal deposit	g. временной масштаб
8. desert conditions	h. облачный покров
9. climate system	i. горный хребет

Упражнение 5.

Заполните, где это возможно, таблицу, вставив недостающие части речи.

v.	n.	adj.	adv.
demonstrate	variability	radiative	approximately
cause	intensification		substantially

Упражнение 6.

Прочитайте следующие выражения:

AD 1650-1700; 410,000 years; ±50 ppm; CH_4; 80%; 150 times.

Упражнение 7.

Подберите определение к каждому словосочетанию.

1. give rise	a. подвергаться
2. drive home	b. испытывать
3. take place	c. продвигаться вперед
4. lie open	e истощаться
5. put to the test	f. вызывать
6. gain ground	g. принимать участие
7. run short	h. убеждаться в правильности факта
8. take part	i. иметь место

Упражнение 8.

Прочитайте текст и найдите в нем ответы на следующие вопросы:

1. Каковы внутренние климатообразующие факторы?
2. Каковы последствия роста глобальной температуры?
3. Какова роль облачного покрова с точки зрения механизма обратной связи?

(Контрольное время – 7 минут)

Short-term forcing and feedback

Internal radiative forcing agents are mainly those that involve changes in atmospheric composition, cloud cover, aerosols and surface albedo. Although subject to long-term changes, it is their susceptibility to short-term anthropogenic changes that makes them of particular interest to contemporary climatologists. The interactive relations between short- term external solar radiative forcing and these internal radiative forcing agents lie at the heart of the understanding and prediction of short-term global climatic changes, through a complex set of feedback mechanisms, which can be either positive (i.e. self-enhancing) or negative (i.e. self-regulating or damping).

Positive feedback mechanisms affecting global climate appear to be widespread and to be particularly effective in response to temperature changes, which is a matter of especial current concern. Increases in global temperature produce increases in atmospheric water vapour, increases in plant respiration, decreases in CO_2 dissolved in the oceans, and an increase in methane emissions from wetlands. All of these, in turn, tend to increase the global concentration of greenhouse gases and, hence, to increase global temperature further. Ice and snow cover is involved in especially important positive feedback effects in that a more extensive cover creates higher albedo and lower temperatures, which, in turn, will further extend the ice and snow cover, producing additional cooling. Conversely, a warming effect, which melts ice and snow cover, decreases the surface albedo, allows the absorption of more incoming solar radiation and leads to increased surface heating and higher temperatures.

Unfortunately, negative feedback mechanisms appear to be much less important in the face of short-term radiative forcing and it is important to understand that, for example, they can only reduce the rate of warming but cannot, of themselves, cause global cooling. Cloud cover is a particularly complex global feedback mechanism, producing both positive and negative effects. For example, negative feedback may oper-

ate when increased global heating leads to greater evaporation and greater amounts of high-altitude cloud cover, which will reflect more incoming solar radiation and thus damp down the global temperature rise.

Упражнение 9.

Выберите из текста *Short-term forcing and feedback* 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 10.

Переведите текст письменно. (Контрольное время – 25 минут)

Changes in climate involve factors both external to and within the climate system. External ones include solar variability, astronomical effects on the earth's orbit, and volcanic activity. Internal factors include natural variability within the climate system, and feedbacks between the atmosphere, ocean and land surface. During the last century, human-induced climatic change on local and global scales has become a reality, primarily through changes in atmospheric composition and surface properties. Climatic changes on geological time scales involve continental drift, volcanic activity and possible changes in solar output. Over the last few million years, glacial-interglacial cycles appear to have been strongly controlled by astronomical variations in the earth's orbit, although atmosphere-ocean-cryosphere feedbacks must also be involved in amplifying the initial changes in solar radiation.

Possible causes of climatic change are examined from the point of view of the global atmosphere-earth-ocean-ice system and with respect to forcing and feedback mechanisms. Whereas longer-term changes are probably due to astronomical forcing mechanisms, short-term changes (i.e. the last 100 years) appear to be more obviously linked to anthropogenic factors. These are mainly changes in atmospheric composition, including aerosol loading, depletion of ozone and destruction of world vegetation. Natural and anthropogenic aerosol effects appear to be particularly important, but their net effect remains uncertain.

Упражнение 11.

Составьте 5 общих вопросов к тексту.

Упражнение 12.

(Парная работа) Ответьте на вопросы, составленные в упражнении 11.

Lesson 2

Упражнение 1.

Подумайте и приведите 10–15 слов, которые могут встретиться в тексте. Прочитайте и переведите текст.

Anthropogenic factors of recent climatic change

The growing influence of human activities on the environment is being increasingly recognized and concern over the potential for global warming caused by such anthropogenic effects is growing. Four categories of climatic variable are subject to change and will now be considered in turn. Changes in atmospheric composition associated with the explosive growth of world population, industry and technology have led to drastic increases in the concentration of greenhouse gases. The tendency of these increases is to increase radiative forcing and global temperatures; the percentage apportionment of radiative forcing of these greenhouse gas has increased since the preindustrial era, together with the associated ranges of uncertainty and levels of confidence assigned to each factor. The radiative forcing effect of the minor trace gases is projected to increase steadily. Up to 1960, the cumulative CO_2 contribution since AD 1750 was about 67 per cent of the calculated 1.2W m^{-2} forcing, whereas for 1980-90 the CO_2 contribution decreased to 56 per cent, with CFCs contributing 24 per cent and methane 11 per cent. For the entire period from AD 1765 to 2050, the CO_2 contribution is projected to range from 4.15 W m^{-2}, out of a 6.5 W m^{-2} total (65 per cent), for a 'business-as-usual' scenario to 2.6 Wm^{-2}, out of a 4.0 Wm^{-2} total (65 per cent), if emission control policies are implemented rapidly.

The recent increase in global temperature forcing by the release of CFCs is particularly worrying. Ozone, which at high altitudes absorbs incoming short-wave radiation, is being dramatically destroyed above 25 km in the stratosphere by emissions of H_2O and NO_X by jet aircraft and by surface emissions of N_2O by combustion and, especially, of CFCs. It is estimated that CFCs are now accumulating in the atmosphere five times faster than they can be destroyed by ultraviolet radiation. Ozone circulates in the stratosphere from low to high latitudes and thus the occurrence of ozone in polar regions is particularly diagnostic of its global concentration. In October 1984, an area of marked ozone depletion (the so-called 'ozone hole') was observed in the lower strato-

sphere (i.e. 12-24 km) centred on, but extending far beyond, the Antarctic continent. Ozone depletion is always greatest in the Antarctic spring, but in this year the ozone concentration was more than 40 per cent lower than that of October 1977. By 1990, Antarctic ozone concentrations had fallen to about 200 Dobson units in September-October, compared with 400 units in the 1970s. In the extreme years (1993-5), record minima of 116 D.U. have been recorded at South Pole. It has been estimated that, because of the slowness of the global circulation of CFCs and of its reaction with ozone, even a cut in CFC emissions to the level of that in 1970 would not eliminate the Antarctic ozone hole for at least fifty years.

The role of tropospheric aerosols in climate forcing and the magnitude of such effects are poorly known. There are four key aerosol types and these have a variety of effects:

1 black carbon – absorbs solar radiation; changes the vertical temperature gradient,

2 water-soluble inorganic species (SO_2, NO_3, NH_4 - backscatter of direct beam solar radiation, indirect effect of CCN on cloud albedo and cloud droplet lifetime.

3 condensed organic species – as (2)

4 mineral dust – as (1), (2) and absorption/ emission of infrared radiation.

The global mean forcing exerted by the principal aerosols is as follows:

sulphate aerosols – 0.6 W m^{-2},

biomass burning aerosols – 0.8 *W* m^{-2}.

mineral dust – 1.0 W m^{-2}.

However, it should be emphasized that about 88 per cent of the total aerosols input is of natural origin. The indirect effects of cloud condensation nuclei (CCN) from anthropogenic sources are undetermined. Nevertheless, a ±15 per cent change of CCN within marine stratus clouds, which cover about 25 per cent of the earth, could change the global energy balance by ± 1 W m^{-2}.

Indirect anthropogenic factors, such as increasing population pressures leading to overgrazing and forest clearance, may increase desertification which also contributes to the increase of wind-blown soil. The 'dust-bowl' years of the 1930s in the United States and the African Sahel drought in the 1970s were observed. Evidence from the Soviet Union shows a sharp rise in dust-fall on mountain snow-fields from 1930s

to 1960s, and atmospheric turbidity increased by 57 per cent over Washington, DC, over the period 1905-64, and by 85 per cent over Davos, Switzerland (1920-58). The presence of particles in the atmosphere increases the backscateer of short-wave radiation, thereby increasing the planetary albedo and causing cooling, but the effect on infrared radiation is one of surface warming. The net result is complicated by the surface albedo. Man-made aerosols cause net warming over snow and ice and most land surfaces, but cooling over the oceans, which have a low albedo. Natural aerosols probably cause general cooling. The overall effect on global surface temperature remains uncertain.

Changes in surface albedo occur naturally with season, hut climatic forcing is also caused by anthropogenic vegetation changes. Human effects on vegetation cover have a long history. Deliberate burning of vegetation by Aborigines in Australia has been practised for perhaps 40,000 years. However, significant deforestation began in Eurasia during Neolithic times *(c.* 5000 BP), as evidenced by the appearance of agricultural species and weeds. Deforestation expanded in these areas between about AD 700 and 1700 as populations slowly grew, but it did not take place in North America until the westward movement of settlement in the eighteenth and nineteenth centuries. During the last half-century extensive deforestation has occurred in the tropical rainforests of South-east Asia, Africa and South America. Estimates of current tropical deforestation suggest losses of 10^5 km^2/year, out of a total tropical forest area of $9 \cdot 10^6$ km^2. This annual figure is more than half the total land surface at present under irrigation and twice the annual loss of marginal land to desertification. Forest destruction causes an increase in albedo of perhaps 10 per cent locally, with consequences for surface energy and moisture budgets. However, the large-scale effect of deforestation in temperate and tropical latitudes on global surface albedo is estimated to be <0.001. It should also be noted that deforestation is difficult to define and monitor; it can refer to loss of forest cover with complete clearance and conversion to a different land use, or species' impoverishment without major changes in physical structure. The term desertification, applied in semi-arid regions, creates similar difficulties. The process of vegetation change and associated soil degradation is not solely attributable to human-induced changes but is triggered by natural rainfall fluctuations.

Упражнение 2.

Ответьте на следующие вопросы:

1. Каковы причины разрушения озонового слоя Земли?
2. Какова роль атмосферных аэрозолей в изменении глобального климата?
3. Каковы косвенные антропогенные факторы?
4. С чем связано антропогенно-обусловленное изменение планетарного альбедо?
5. Каким образом вырубка лесов влияет на климат?

Упражнение 3.

Найдите в тексте термины, соответствующие следующим выражениям.

acknowledge	clearly	still	destruct
possible	trend	however	by changing
make up	changeable	result in	

Упражнение 4.

Словам в левой колонке подберите антонимы в правой колонке.

1. warming	a. low
2. rapidly	b. within
3. high	c. expand
4. destroy	e cooling
5. beyond	f. absence
6. presence	g. with
7. reduce	h. slowly
8. without	i. create

Упражнение 5.

Переведите следующие слова на русский язык.

increasingly	so-called	should	last	since
each	even	indirect	twice	always
particularly	at least	thereby	solely	perhaps

Упражнение 6.

Из слов в правой и левой колонке образуйте цепочки существительных.

world	forcing
surface	budget
ozone	fluctuation
climate	population
forest	cover
vegetation	depletion
moisture	emission
rainfall	clearance

Упражнение 7.
Прочитайте следующие выражения
1750, 1.2 W m^{-2}, the 1970s, $9 \cdot 10^6$ km^2, 5000BP.

Упражнение 8.
Прочитайте текст. (Контрольное время – 7 минут)

Circulation changes

Tile immediate cause of the recent climatic fluctuations appears to be the strength of the global wind circulation. The first thirty years of last century saw a pronounced increase in the vigour of the westerlies over the North Atlantic, the north-east trades, the summer monsoon of South Asia and the southern hemisphere westerlies (in summer). Over the North Atlantic, these changes consisted of an increased pressure gradient between the Azores high and the Icelandic low, as the latter deepened, and also between the Icelandic low and the Siberian high, which spread westwards. These changes were accompanied by more northerly depression tracks, and this resulted in a significant increase in the frequency of mild south-westerly airflow over the British Isles between about 1900 and 1930, as reflected by the average annual frequency of Lamb's westerly airflow type. For 1873-97, 1898-1937, 1938-61 and 1962-95 the figures are 27, 38, 30 and 21 per cent, respectively. Coinciding with the westerly decline, cyclonic and anticyclonic types increased substantially. The decrease in westerly airflow during the last thirty-year interval, especially in winter, is linked with greater continentality in Europe. These regional indicators reflect a general decline in the overall strength of the mid-latitude circumpolar westerlies, accompanying an apparent expansion of the polar vortex.

Global climate is closely related to the position and strength of the subtropical high-pressure cells. It has been estimated that a warming of the Arctic tropopause (winter +10°C; summer +3°C; annual +7°C), without changing equatorial or Antarctic temperatures, would cause an annual shift of the subtropical high-pressure belt from its present average position of 37°N to 41–43°N (i.e. some 100–200 km in summer but as much as 800 km in winter). This would bring drought to the Mediterranean, California, the Middle East, Turkestan and the Punjab, as well as displacing the thermal equator from 6°N to 9–10°N, increasing the desertification in the belt 0–20°.

Упражнение 9.

Ответьте на следующие вопросы, исходя из информации в тексте:

1. Что является непосредственной причиной современных колебаний климата?
2. Как изменились траектории циклонов?
3. Какие черты приобрел климат в Европе?
4. Какие изменения произошли в циркумполярном западном переносе средних широт и полярном вихре?

Упражнение 10.

Выпишите 10 ключевых слов из текста в упражнении 8.

Упражнение 11.

Письменно переведите текст. (Контрольное время – 35 минут)

Energy budgets

The key to these atmospheric variations must be linked to the heat balance of the earth-atmosphere system and this addresses us to the fundamental energy considerations.

The evidence for fluctuations greater than 0.1 per cent in the 'solar constant' is inconclusive, although significant variations apparently do occur in the emission of high-energy particles and ultraviolet radiation during brief solar flares. All solar activity follows the well-known cycle of approximately eleven years, which is usually measured with reference to the period between sunspot maximum and minimum, but nu-

merous attempts to establish secure correlations between sunspot activity and terrestrial climates have produced mostly negative results. Nevertheless, a statistical relationship has been found between the occurrence of drought in the western United States over the last 300 years and the approximately 22-year double (Hale) cycle of the reversal of the solar magnetic polarity. Drought areas are most extensive in the two to five years following a Hale sunspot minimum (i.e. alternate eleven-year sunspot minima).

Changes in atmospheric composition may also have modified the atmospheric heat budget. The presence of increased amounts of volcanic dust and sulphate aerosols in the stratosphere is one suggested cause of the 'Little Ice Age'. Major eruptions can result in a surface cooling of perhaps 0.2°C for a few years after the event. Hence, frequent volcanic activity would be required for persistently cooler conditions. Conversely, it is suggested that reduced volcanic activity after 1914 may have contributed in part to the early twentieth-century warming. New interest in this question has been aroused by eruptions of El Chichon (March 1982) and Mount Pinatabo (June 1991). It has been estimated that huge volcanic eruptions such as these, can, during a decade, produce a forcing effect on global temperature about one-third as great as that exerted by greenhouse gases - but in the opposite direction (i.e. to produce surface cooling). The role of low-level aerosols is also complex. These originate naturally, from wind-blown soil and silt for example, as well as from atmospheric pollution due to human activities (industry, domestic heating and modern transportation).

Блок 6
ENVIRONMENTAL IMPACTS OF CLIMATE CHANGE

Lesson 1

Упражнение 1.

Прочитайте заголовок приводимого ниже текста. Подумайте, о чем в нем может идти речь. Приведите 10–15 слов, которые могут, с Вашей точки зрения, встретиться в тексте.

Прочитайте и переведите текст.

Sea level changes

The mechanisms influencing sea level over the globe are extremely complex. Present sea level is not easy to define, estimates of sea levels over the past 100 years are difficult to make, and predictions over the next 100 years are highly speculative. Sea level changes are influenced by the following mechanisms (those of short time scales – i.e. tens of years-italicized);

1 Changes in ocean water mass – e.g. exchanges with glaciers; changes in the atmosphere-earth-ocean-ice-water distribution.

2 Changes in ocean water volume – e.g. thermal expansion and contraction; salinity changes; changes in atmospheric pressure.

3 Changes in earth crustal levels.

(a) Tectonic – e.g. rise of ocean ridges; sea-floor subsidence; plate movements.

(b) Isostatic – e.g. tectonic loading; *ice and water loading.*

4 Changes in the global distribution of water

(a) Terrestrial rotation effects.

(c) Global axis changes.

(d) Terrestrial gravity variations.

(e) Changes in the attraction of sun and moon.

(f) *Changes in the velocity of ocean currents.*

Over the past 100 years, the general global sea level has risen by 10–25 cm or more, accelerating during the century. This rise has been attributed proportionately to the following causes:

1 Thermal expansion of ocean waters (2–7 cm; i.e. possibly 50 per cent or more). This is difficult to estimate due to lack of knowledge

regarding oceanic circulations, such that estimates vary from 30 to 60 per cent.

2 Glacier and small ice cap melting (2–5 cm; i.e. possibly 30 per cent). Estimates of this contribution to sea level rise go as high as 48 percent.

3 Greenland ice cap melting (very indeterminate). This could be as great as 25 per cent and as little as 5 per cent.

4 Antarctic ice sheet melting. This is very uncertain; the Antarctic ice sheet is a large and complex system with its own internal mechanisms and a mass balance that changes slowly. Some workers believe the balance is positive, which would offset sea level rise. This source has probably not yet contributed greatly to the global sea level rise but may do so in the future.

Uncertainties regarding sea level rise are still considerable, mainly because of our lack of knowledge concerning the behavior of the large ice sheets, especially Antarctica. There is even the possibility that increased global warming may introduce a tendency for sea level to fall because of increased snow accumulation rates in high latitudes. Another outside possibility is that a rise in sea level might cause the West Antarctic ice sheet to be buoyed up and melt bodily (not just around the edges, as in the past) and cause a further catastrophic sea level rise but spread over several hundred years. Final considerations are the possible effects of extreme sea level events (such as tides, waves and storm surges), but these are extremely difficult to predict.

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

Mechanism, globe, complex, thermal, crustal, tectonic, effect, gravity, proportionately, circulation, contribution, sheet, system, balance, positive, tendency, accumulation, catastrophic, final, extreme, storm.

Упражнение 3.

Какие части речи обозначаются в словарях следующими сокращениями:

v., adv., n., adj., conj., num., part., prep., pron.?

Упражнение 4.

Определите, к каким частям речи относятся следующие слова; напишите соответствующие английские сокращения для каждого из них:

Global, first, distribution, of, behavior, that, to, and, greatly, are, contributed, hundred, vary.

Упражнение 5.

Найдите в тексте примеры этих частей речи.

v.	n.	adj.	adv.	num.	prep.	part.

Упражнение 6.

Образуйте причастия 1 и 2 рода из следующих глаголов. Найдите примеры таких причастий в тексте из упражнения 1.

Define, make, offset, introduce, fall, cause, spread, predict.

Упражнение 7.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний:

1. sea level rise	a. движение тектонических плит
2. thermal expansion	b. сложная система
3. mass balance	c. опускание морского дна
4. global warming	d. подъем уровня моря
5. atmospheric pressure	e. баланс массы
6. complex system	f. земная ось
7. plate movement	g. атмосферное давление
8. global axis	h. тепловое расширение
9. sea-floor subsidence	i. глобальное потепление

Упражнение 8.

Прочитайте текст и найдите в нем ответы на следующие вопросы:

1. Где находятся основные запасы углерода?
2. Какова роль океанов в глобальном углеродном цикле?
3. Почему рост концентрации углекислого газа в атмосфере не обязательно приведет к увеличению производительности океана?

(Контрольное время – 5 минут)

The oceans and the global carbon cycle

The oceans play a key role in the global carbon cycle. Photosynthesis by phytoplankton generates organic compounds of aqueous carbon dioxide. Eventually, some of the biogenic matter sinks into deeper water, where it undergoes decomposition and oxidation back into carbon dioxide. This process transfers carbon dioxide from the surface water and sequesters it in the ocean deep water. As a consequence, atmospheric concentrations of CO_2 can be maintained at a lower level than otherwise. This mechanism is known as a 'biologic pump'; long-term changes in its operation may have caused the rise in atmospheric CO_2 at the end of the last glaciation. Ocean biomass productivity is limited by the availability of nutrients and by light. Hence, unlike the land biosphere, increasing CO_2 levels will not necessarily affect ocean productivity; inputs of fertilizers in river runoff may be a more significant factor. In the oceans, the carbon dioxide ultimately goes to produce carbonate of lime, partly in the form of shells and the skeletons of marine creatures. On land, the dead matter becomes humus, which may subsequently form a fossil fuel. These transfers within the oceans and lithosphere involve very long time scales compared with exchanges involving the atmosphere.

Упражнение 9.

Выберите из текста *The oceans and the global carbon cycle* 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 10.

Переведите текст письменно. (Контрольное время – 30 минут)

The oceans and atmospheric regulation

The atmosphere and the surface ocean waters are closely connected both in temperature and in CO_2 concentrations. The atmosphere contains less than 1.7 per cent of the CO_2, held by the oceans, and the amount absorbed by the surface ocean water rapidly regulates the concentration in the atmosphere. The absorption of CO_2 by the oceans is greatest where the water is rich in organic matter or where it is cold. Thus the oceans are capable of regulating atmospheric CO_2, of chang-

ing the greenhouse effect and of contributing to climate change. The most important aspect of carbon cycle linking atmosphere and ocean is the difference between the partial pressure of CO_2 in the lower atmosphere and that in the upper oceanic layer. This results in atmospheric CO_2 being dissolved in the oceans and in some of this being subsequently converted into particulate carbon, mainly through the agency of plankton, ultimately sinking to form carbon-rich deposits in the deep ocean as part of a cycle lasting hundreds of years. Thus two of the major effects of ocean surface warming would be to increase its CO_2 equilibrium partial pressure and to decrease the abundance of plankton. Both of these effects would tend to decrease the oceanic uptake of CO_2 and therefore to increase its atmospheric concentration, thereby producing a positive feedback (i.e. enhancing) effect on global warming. However, the operation of the atmosphere-ocean system is sufficiently complex that, for example, global warming may so increase oceanic convective mixing that the resulting imports of cooler water and plankton into the surface layers might exert a break (i.e. negative feedback) on the system warming.

Упражнение 11.

Составьте 5 общих вопросов к тексту *The oceans and atmospheric regulation.*

Упражнение 12.

(Парная работа) Ответьте на вопросы, составленные в упражнении 11.

Lesson 2

Упражнение 1.

Попытайтесь вспомнить, что Вам известно о влиянии глобального потепления на снежный и ледовый покров Земли.

Подумайте и приведите 10–15 слов, которые могут встретиться в тексте.

Прочитайте и переведите текст.

Snow and ice

The effects of the twentieth-century climate change on global snow and ice cover are apparent in many ways, but the responses differ widely as a result of the different factors and time scales involved. Snow cover is essentially seasonal, related to storm system precipitation and temperature levels. Sea ice is also seasonal around much of the Antarctic continent and the marginal seas of the Arctic Ocean, but the central Arctic has thick multi-year ice. Seasonal (or first-year) ice grows and decays in response to ocean surface temperature, radiation balance, snowfall and ice motion due to winds and currents. The loss of multi-year ice from the Arctic is mainly through ice export. Glacier ice builds up from the net balance of snow accumulation and summer melt (ablation), but glacier flow transports ice towards the terminus, where it may melt or calve into water. In small glaciers the ice may have a residence time of 10s-100s of years, but in ice caps and ice sheets this increases to 10^3–10^6 years.

In the twentieth century there was a rapid retreat of most of the world's glaciers. Glaciers in the North Atlantic area retreated during the 1920s to the mid-1960s and since 1980, due largely to temperature increases, which have the effect of lengthening the ablation season with a corresponding raising of the snowline. In the last 10–15 years the freezing level in the troposphere has risen in the inner tropics by 100–150m, contributing to rapid ice loss on equatorial glaciers in East Africa and the northern Andes. Also in the last decades or so, some glaciers in maritime climates (western North America and Scandinavia) have shown advances, due to heavier snowfalls during warmer winters. Major alpine glaciers in many areas of the world have lost mass and shrunk since the late nineteenth century, whereas smaller ones show short-term

fluctuations in response to climatic variability. Projections for AD 2050 suggest that one quarter of the present glacier mass may disappear.

Another tendency illustrating world warming is the retreat of Arctic sea ice. Ports in the Arctic remained free of ice for longer periods during the 1920s – 50-s for example. This trend was reversed in the 1960-s~70-s, but since the late 1980-s the summer extent of Arctic ice has decreased, with large reductions, particularly in the Eurasian Arctic, in 1990, 1993 and 1995. There appears to be no general trend in Antarctic ice extent, although comprehensive records began only with all-weather satellite coverage in 1973. Sea ice in both polar regions is expected to shrink and thin with continued warming, but modelling of these processes remains rudimentary.

Major iceberg calving events have occurred along the Ross Ice Shelf and on the Larsen Ice Shelf of the Antarctic Peninsular, but the causes of such calving are more related to the long history of the ice shelves and ice dynamics than to recent climate trends.

Snow cover extent shows perhaps the clearest indication of a response to recent temperature trends. Northern hemisphere snow cover has been mapped by visible satellite images since 1966. Compared with the 1970s–mid-1980s, annual snow cover since 1988 has shrunk by about 10 per cent. The decrease is most pronounced in spring and is well-correlated with springtime warming. Winter snow extent shows little or no change. Nevertheless, annual snowfall in North America north of 55° increased during 1950-90. Much work remains to be done to analyse station snowfall and snow depth records for other countries, particularly since these variables are difficult to measure and the design of gauges and wind shields has changed through time. Scenarios for AD 2050 suggest a shorter snow cover period in North America, with a decrease of 70 per cent over the Great Plains. In alpine areas, snow lines will rise by 100–400m, depending on precipitation.

Упражнение 2.

Ответьте на следующие вопросы:

1. What does seasonal ice cover depend upon?
2. Have the world's glaciers moved forward or backward during the last two centuries?
3. How much has the freezing level in the troposphere in the inner tropics risen by?

4. How much of the present glacier mass might have disappeared by 2050?
5. How long were ports in the Arctic free of ice in different periods of the XX century?
6. When did records of Antarctic ice extent begin?
7. What are the trends of sea ice in the polar regions like?
8. How long has northern hemisphere snow cover been mapped?
9. Did annual snowfall in North America north of 55° go up or down in the middle of the XX century?
10. What are the prospects of snow cover in North America for 2050?

Упражнение 3.

Найдите в тексте термины, соответствующие следующим выражениям.

broadly	go back	quick	going up and
rainfall	thanks to	go up	change direction
summer melt	become longer	ten years	opposite
reduce	carry	mountain (adj.)	every year

Упражнение 4.

Добавьте одно или более слов в каждую группу.

all-weather satellite	multi-year	XX century climate
snow cover	snow depth	iceberg calving
ocean surface	storm system	northern hemisphere snow

Упражнение 5.

Переведите следующие слова на русский язык.

through	perhaps	also	around	since
although/though	nevertheless	as well as	about	over
particularly	whereas	which	therefore	such/so

Упражнение 6.

Из слов в правой и левой колонке образуйте цепочки существительных.

ice	images
snow	surface
satellite	range

temperature	loss
summer	cover
springtime	flow
glacier	melt
ocean	advances

Упражнение 7.

Вставьте пропущенные буквы в приведенные ниже слова из текста:

- - nt- bu- e, r - co~s, -ncr--se, -aus-, c-r-e-t, r- - r- a t, -ar-t-me, -e-gt-en, s-r-nk, -cc--, -lu--ua--on, re--in, m-a-ur-.

Упражнение 8.

Прочитайте следующие выражения:

1989, 40°S, 107, the 1920s, 75%, *lA, Va, 0*.25.

Упражнение 9.

Вставьте в пропуски в тексте подходящие слова: *contributes, although, those, frozen, a little, level, dissolved, reflecting*.

Glaciers and ice sheets both affect and are affected by changes in Earth's climate.

They are _____ fresh-water reservoirs that change volume in response to changesin temperature and snowfall. Were the ice sheets in Greenland and Antarctica to melt entirely, global sea would rise about 75 meters.

____ great polar ice sheets also contribute to the formation of cold salty sea water that sinks to fill the deep ocean. When the ice forms, it uses only water; the salts are left behind, increasing the water salinity. Ice and snow play a role in the global energy balance by _____ from 60 to 90 per cent of the solar radiation they receive.

On a scale more relevant to peoples' daily lives, the seasonal melting of mountain glaciers to summertime river flow and to the ongoing sea level rise.

Today permanent ice covers _____ less than 10 per cent of Earth's land surface, yet contains almost 87 per cent of its fresh water. _____ glaciers and ice caps make up less than 1 per cent of Earth's terrestrial ice volume, their small size allows them to respond rapidly to climate change.

Упражнение 10.

Прочитайте текст за 10 минут и передайте его содержание максимально подробно.

Human influences

Human influences can alter soil water conditions in a large number of ways, ranging from irrigation schemes, which considerably increase the amount of water entering the soil, to the construction of large impermeable surfaces in urban areas, which prevent water from infiltrating into the soil. These effects describes in engineering and agricultural texts. Accordingly, only a brief account of a few examples given below.

Agricultural practices have the most widespread effect on soil water conditions. Irrigation and artificial drainage are used throughout the world as a means to increase crop production. Agricultural drainage schemes comprise open ditches or surface pipes. These are deeper and closer together than the natural stream channels, so increasing the hydraulic gradient in the soil and lowering the water table more rapidly between storms than would otherwise occur. A detailed account of the distribution and purpose of field drainage in England and Wales, the most intensively drained part of Europe, was given by Robinson and Armstrong.

Tillage and cultivation operations may also alter the movement and distribution of soil water. Ploughing increases the pore spaces in the upper soil and may encourage lateral flow in the topsoil, with less downflow into the subsoil. It is showed by tracer studies that ploughing disrupts the vertical continuity with pores in the soil below. Infiltrating water is found to penetrate to greater depths on land that had not been ploughed.

A change in agricultural land use from grassland to arable cropping may also affect interception and evaporation losses, especially if the arable farming leaves the soil bare at times of the year. Heavy rainfall on land with little vegetation cover may lead to crusting and sealing of the soil surface, reducing infiltration. Forestry may have a large effect on interception and evaporation losses, causing soils under trees to be much drier than under other types of vegetation. In areas where the natural water table is close to the ground surface, groundwater abstraction may lower the water table, causing significant drying of the soil

and a reduction in plant growth. The most extreme case of human influence on soil water conditions, however, perhaps is found in areas of steep topography, where deforestation and bad farming practices lead to accelerated erosion and may, in severe cases, ultimately result in the complete destruction of the soil.

Упражнение 11.

Письменно переведите текст. (Контрольное время – 25 минут)

Hydrology

The difficulties of deducing the possible effects of climate change on hydrological regimes stem from attempts to adapt the essentially large-scale climatic predictions derived from General Circulation Models to the smaller catchment scales appropriate to hydrological modelling; from errors in the climatic and hydrological data; and from converting climatic inputs into hydrological responses.

The climatic change predicted by current modelling may be expected to lead to:

1. A more vigorous world hydrological cycle.
2. More severe droughts and/or floods in some places and less severe ones in others.
3. An increase in precipitation intensities with possibly more extreme rainfall events.
4. Greater hydrological effects of climate change in drier areas than in wetter ones.
5. An increase in overall potential evapotranspiration.
6. An increase in the variability of river discharges along with that of rainfall.
7. A shift of runoff peak times from spring to winter in continental and mountain areas if snowfall decreases.
8. The greatest falls in lake water levels in dry regions with high evaporation.

The implication that the hydrological impacts of climate change will be greatest in currently arid or semi-arid regions may well mean that the more severe runoff events there will be particularly destructive in terms of soil erosion.

Lesson 3

Упражнение 1.

Прочитайте и переведите текст.

Vegetation

An increase in CO_2, may he expected to enhance global plant growth up to a saturation value of possibly around 1,000 ppmv, when a saturation limit may be reached. However, deforestation could decrease the biosphere's capacity to act as a carbon sink. A sustained increase of only 1°C can cause considerable change in tree growth, regeneration and species extent. Species migrate only slowly but, eventually, extensive forested areas may change to new vegetation types, and it has been estimated that 33 per cent of the present forest area could be affected, with as high as 65 per cent of the boreal zone being subject to change. Alpine tree lines appear to be quite resistant to climatic fluctuations. However, surveys of plant species on peaks in the European Alps indicate an upward migration of alpine plants by 1-4 m per decade during this century.

Tropical forests are likely to be affected more by human deforestation than by climate change. However, decreases of soil moisture are particularly destructive in hydrologically marginal areas. In the Amazon, climatic predictions support the idea of increased convection, and therefore of rainfall, in its western equatorial portion, where present rainfall is most abundant. Because of the particularly high temperature rises predicted for the high northern latitudes, boreal forests are expected to be strongly affected by their advance northwards into tundra regions. This may produce the positive feedback effect of further regional warming because of the lower albedo of forests during the snow season. Climate change over the next 100 years may be expected to exert the least changes on temperate forests.

Wetlands at present cover 4-6 per cent of the land surface, having been reduced by human activities by more than half during the past century. Climate change will affect wetlands mainly by altering their hydrological regimes. Although general predictions are difficult to make, it is believed that eastern China, the USA and southern Europe will suffer a natural decline in the area of wetlands during the next century, decreasing the methane flux to the atmosphere.

Drier regions may be expected to be more profoundly affected than wet ones. Rangelands (including grasslands, shrublands, savannas, hot and cold deserts, and tundra) occupy 51 per cent of the terrestrial land surface, contain 36 per cent of the world's total carbon in their biomass and support half the world's livestock. The lower-latitude rangelands are most at risk both because an increase in CO_2 (increasing the carbon/nitrogen ratio) will decrease the nutrient value of forage and because the increasing frequency of extreme events will cause environmental degradation. Most deserts are likely to become better and not significantly wetter, increases in rainfall being generally associated with increased storm intensity. Greater wind speeds and evaporation may be expected to increase wind erosion, capillary rise and salinization of soils. Central Australia is one of the few places where desert conditions may improve.

It is obvious from the foregoing that a major effect of climate change involving global warming is that desiccation and soil erosion will increase in currently semi-arid regions, rangelands and savannas adjacent to the world's deserts. This will increase the current rate of desertification, which is proceeding at six million hectares per year partly due to high rainfall variability and partly to unsuitable human agricultural activities such as overgrazing and over-intensive cultivation.

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

regeneration, type, extensive, migration, idea, tundra, regional, season, human, hydrological, regime, natural, biomass, risk, degradation, intensity, erosion, salinization, effect, hectare, agricultural, cultivation.

Упражнение 3.

Заполните таблицу, образовав недостающие части речи.

v.	n.	adj.	adv.
	increase		particularly
suggest			
	response		
relate			

Упражнение 4.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *Vegetation*:

1. saturation value	a. полузасушливый регион
2. considerable changes	b. главным образом
3. climatic fluctuation	c. современная скорость
4. more then half	d. уровень насыщения
5. mainly	e. значительные изменения
6. environmental degradation	f. леса умеренной зоны
7. semi-arid region	g. из-за
8. current rate	h. деградация окружающей среды
9. temperate forests	i. однако
10. however	j. колебания климата
11. because of	k. более половины

Упражнение 5.

Составьте 5 вопросов к первому абзацу текста *Vegetation.*

Упражнение 6.

(Парная работа) Ответьте на вопросы в упражнении 6.

Упражнение 7.

Найдите подлежащее в каждом предложении второго абзаца текста *Vegetation.*

Упражнение 8.

Вставьте соответствующий предлог и подберите определение к каждому слову*: upon off from in out for on over*.

1. carry …	a. зависеть от
2 depend …	b. продолжать
3. go …	c. быть следствием
4. look …	e. преодолевать
5. result …	f. искать
6. give	g. взлетать
7. take	h. уступать
8. get	i. выполнять

Упражнение 9. Прочитайте текст и найдите ответы на следующие вопросы. (Контрольное время – 7 минут):

1. Каковы два основных способа воздействия вырубки мировых лесов на климат Земли?
2. К каким изменениям в составе атмосферы привело бы уничтожение тропических лесов?
3. Каким образом вырубка тропических лесов сказалась бы на сезонном характере осадков, уровне грунтовых вод, поверхностном стоке?
4. Может ли уничтожение лесов привести к деградации почвенного покрова и изменению температурного режима?

Deforestation

Deforestation affects world climate in two main ways – first, by altering the atmospheric composition and, second, by affecting the hydrological cycle and local soil conditions:

1 Forests store great amounts of carbon dioxide, so buffering the carbon dioxide cycle in the atmosphere. The carbon retained in the vegetation of the Amazon basin is equivalent to at least 20 per cent of the entire atmospheric CO_2. Destruction of the vegetation would release about four-fifths of this to the atmosphere, about one-half of which would dissolve in the oceans, but the other half would be added to the 16 per cent increase of atmospheric CO_2 already observed this century. The effect of this would be to accelerate the increase of world temperatures. A further effect of tropical forest destruction would be to reduce the natural production of nitrous oxide. Tropical forests and their soils produce up to one-half of the world's nitrous oxide, which helps to destroy stratospheric ozone. Any increase in ozone would warm the stratosphere, but lower global surface temperatures.

2 Dense tropical forests have a great effect on the hydrological cycle through their high evapotranspiration and their reduction of surface runoff (about one-third of the rain never reaches the ground, being intercepted and evaporating off the leaves). Forest destruction decreases evapotranspiration, atmospheric humidity, local rainfall amounts, interception, effective soil depth, the height of the water table and surface roughness (and thereby atmospheric turbulence and heat transfer). Conversely, deforestation increases the seasonality of rainfall, surface run-

off, soil erosion, soil temperatures and surface albedo (and therefore near-surface air temperatures). All these tendencies operate to degrade existing primary and secondary tropical forests into savanna. Models designed to simulate the operation of Amazonian forests having a 27°C air temperature and a mean monthly rainfall of 220 mm (falling in four showers every third day, each lasting 30 minutes at an intensity of 0.003 mm s^{-1}) predict that their degradation to savanna conditions would lead to a decrease of evapotranspiration by up to 40 per cent, an increase of runoff from 14 per cent of rainfall to 43 per cent, and an average increase of soil temperature from 27 to 32°C.

Упражнение 10.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *Deforestation*:

1. soil conditions	a. по крайней мере
2. tropical forests	b. окись азота
3. evapotranspiration	c. водное зеркало
4. at least	d. перенос тепла
5. surface ranoff	e. шероховатость поверхности
6. water table	f. совокупное испарение
7. surface roughness	g. структура почвы
8. heat transfer	h. тропические леса
9. nitrous oxide	i. состав атмосферы
10. atmospheric composition	j. поверхностный сток

Упражнение 11.

Найдите в каждом предложении текста *Deforestation* подлежащее и сказуемое. Определите время и залог сказуемого.

Упражнение 12.

Письменно переведите текст. (Контрольное время – 15 минут)

Forests

Forests have a lower albedo (<0.10 for conifers) than most other vegetated surfaces (0.20–0.25). Their vertical structure produces a number of distinct microclimatic layers, particularly in tropical rainforests. Wind speeds are characteristically low in forests and trees form

important shelter belts. Unlike short vegetation, various types of tree exhibit a variety of rates of evapotranspiration and thereby differentially affect local temperatures and forest humidity. The effect of forests on precipitation has not yet been resolved but they may have a marginal topographic effect under convective conditions in temperate regions. The disposition of forest moisture is very much affected by canopy interception and evaporation, but forested catchments appear to have greater evapotranspiration losses than ones with a grass cover. Another major feature of forest microclimates is their lower temperatures and smaller diurnal ranges, compared with surrounding areas.

Блок 7
MATTER AND ENERGY CYCLING IN ECOSYSTEMS

Lesson 1

Упражнение 1.

Прочитайте заголовок приводимого ниже текста. Подумайте, о чем в нем может идти речь. Приведите 10–15 слов, которые могут, с Вашей точки зрения, встретиться в тексте.

Прочитайте и переведите текст.

Carbon and oxygen cycles

Carbon is the basic building block of the large organic molecules necessary for life, including simple carbonhydrates or sugars (such as glucose), complex carbonhydrates, fats, proteins, and nucleic acids such as DNA. DNA molecules in the cells of plants and animals carry genetic information and chemical instructions for manufacturing various proteins living organisms need.

Most land plants obtain their carbon by absorbing carbon dioxide gas, which makes up 0,03% of the atmosphere, through pores in leaves. They obtain the oxygen atoms they need from the oxygen in carbon dioxide and from water molecules in soil or bodies of water. The ocean's microscopic floating plants, known collectively as phytoplankton, get their carbon from atmospheric carbon dioxide that dissolved in ocean water.

Chlorophyll molecules and some other pigments in the cells of green plants absorb solar energy and use it to combine carbon dioxide with water to form glucose along with oxygen gas. This complex process in which radiant energy from the sun is converted into chemical energy stored in plant tissue is called photosynthesis.

Plants and animals transform a portion of glucose and other, more complex, carbon-containing molecules they synthesise (plants) or eat (consumers) back into carbon dioxide and water by the process of cellular respiration. The chemical energy released in this complex process drives the physical and chemical changes needed for plants and animals to survive, grow and reproduce.

The carbon dioxide released by cellular respiration in all plants and animals is returned to the atmosphere and water for reuse by pro-

ducers. Although the overall chemical reaction involved in cellular respiration is the reverse of that for photosynthesis, many of the detailed chemical reactions involved in the processes are different.

Photosynthesis and cellular respiration are the basis of carbon and oxygen cycles. Through these two interconnected cycles, plants produce food and oxygen needed by animals and absorb carbon dioxide given off by animals.

Some of the earth's carbon is tied up for long periods in fossil fuels – coal, petroleum, natural gas, peat, oil shale, tar sands, and lignite – formed over millions of years in the lithosphere. The carbon in these mineral deposits remains locked deed in the earth's crust until it is released to the atmosphere as carbon dioxide when fossil fuels are extracted and burned. Some of the earth's carbon is also locked for millions of years in deposits of carbonate rocks below the seafloor until movements of the earth's crust expose these rocks as part of an island or a continent. The carbon then reenters the cycle very slowly through erosion and other physical and chemical weathering processes that release it as carbon dioxide into the atmosphere.

Human beings intervene in the carbon and oxygen cycles in two ways that increase the average amount of carbon dioxide in the atmosphere. First, we remove forests and other vegetation without sufficient replanting, so that fewer plants are available worldwide to convert carbon dioxide in the atmosphere to organic nutrients. Second, we burn fossil fuels and wood.

Упражнение 2.

Прочитайте следующие слова и определите их соответствия в русском языке:

Cycle, organic, molecule, nucleic, genetic, information, chemical, physical, organism, gas, atom, pore, ocean, atmospheric, microscopic, phytoplankton, pigment, form, glucose, energy, photosynthesis, transform, synthesise, complex, detailed, process, period, mineral, lithosphere, continent.

Упражнение 3.

Какие части речи обозначаются в словарях следующими сокращениями:

v., adv., n., adj., conj., num., part., prep., pron.?

Упражнение 4.

Определите, к каким частям речи относятся следующие слова; напишите соответствующие английские сокращения для каждого из них:

Animal, first, respiration, for, cellular, they, in, and, widely, is, extracted, million, remove.

Упражнение 5.

Найдите в тексте *Carbon and oxygen cycles* примеры этих частей речи.

v.	n.	adj.	adv.	num.	prep.	part.

Упражнение 6.

Заполните пропуски, используя суффиксы: *~able, ~al/~ial, ~ful, ~ic, ~ine, ~ish, ~ive, ~less.*

Diamond is a form of pure … *(crystal)* carbon which has been formed under great heat and pressure and brought to the surface of the Earth by … *(volcano)* activity. It is the hardest … *(nature)* substance in the world with a very high … *(refract)* power giving specific …*(optic)* properties, above all, a particularly clear and brilliant reflection of light. The most … *(value)* diamonds are completely … *(without colour)* They are, however, extremely rare; the majority having a … *(slightly yellow)* or … *(slightly green)* colour caused by different mineral impurities and gases. Diamond feels cold to the touch as it dissipates heat very quickly, hence, checking thermal conductivity is a … *(rely)* method of detection. Cheaper synthetic diamonds are now being made for … *(industry)* applications. These are particularly … *(use)* for cutting tools.

Упражнение 7.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *Carbon and oxygen cycles*:

1. carbon dioxide	a. ископаемое топливо
2. living organism	b. процесс выветривания
3. plant tissues	c. клеточное дыхание
4. radiant energy	d. ткани растений
5. cellular respiration	e. углекислый газ

6. interconnected cycles	f. среднее количество
7. mineral deposits	g. живой организм
8. fossil fuel	h. лучистая энергия
9. weathering process	i. взаимосвязанные циклы
10. average amount	j. минеральные отложения

Упражнение 8.

Прочитайте текст и найдите в нем ответы на следующие вопросы:

1. От чего зависит важность того или иного элемента для живых организмов?
2. Что способствует круговороту элементов?
3. Что произошло бы без биогеохимических циклов?

(Контрольное время – 7 минут)

Biogeochemical cycles

Of the earth's 92 naturally occurring elements, only 20 to 30 are constituents of living organisms and thus are cycled through the biosphere. In chemical terms, life can almost be summed up in five words: carbon, oxygen, hydrogen, nitrogen, and phosphorus. These chemicals as elements and compounds make up 97% of the mass of your body and more than 95% of the mass of all living organisms.

The remaining 15 to 25 elements needed in some from for the survival and good health of plants and animals are required only in relatively small, or trace, amounts. The importance of a particular chemical to a living organism varies with the physical and chemical from and location of the chemical. For example, plants obtain most of their carbon in the form of carbon dioxide gas from the atmosphere or water, and most of their nitrogen and phosphorus as nitrate ions and phosphate ions from soil water in which containing these ions are dissolved.

Only a small portion of the earth's chemicals exist in forms useful to plants and animals. Fortunately, the essentially fixed supply of elements and compounds needed for life is continuously cycled through the air, water, soil, plants, and animals and converted to useful forms in biogeochemical cycles (bio meaning "living", geo for water, rocks, and soil, and chemical for the matter changing from one form to another). These cycles, driven directly or indirectly by incoming energy from the

sun, include the carbon, oxygen, nitrogen, phosphorus, and hydrologic cycles.

Thus a chemical may be part of an organism at one moment and part of its nonliving environment at another moment. This means that one of the oxygen molecules you just inhaled may be one inhaled previously by you, your grandmother, King Tut thousands of years ago, or a dinosaur millions of years ago.

Similarly, some of the carbon atoms in the skin converting your right hand may once have been part of a leaf, a dinosaur hide, or a limestone rock. Without the biogeochemical cycles, the entire world would soon be knee-deep in plant litter, dead animal bodies, animal wastes, and garbage.

Упражнение 9.

Выберите из текста *Biogeochemical cycles* 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 10.

Переведите текст письменно. (Контрольное время – 30 минут)

Phosphorus cycle

Phosphorus, mainly in the of phosphate ions, is an essential nutrient of both plants and animals. It is a major constituent of the genetic material coded in DNA molecules and the main component of bones and teeth. It is also used in some commercial fertilizers.

Various form of phosphorus are cycled through the lower atmosphere, water, soil, and living organisms by the phosphorus cycle. The major reservoirs of phosphorus are phosphate rock deposits on land and in shallow ocean sediments. Some phosphates released by the slow breakdown of phosphate rock deposits are dissolved in soil water and taken up by plant roots. Animals get their phosphorus by eating plants or animals that have eaten plants. Animal wastes and the decay products of dead animals and plants return much of this phosphorus to the soil, rivers, and eventually to the ocean bottom as insoluble forms of phosphate rock. Large amounts of phosphate are eroded from the land to the oceans each year by natural processes and human activities.

People intervene in the phosphorus cycle in several ways. First, large quantities of phosphate rock are dug up, mostly from shallow ocean deposits, and used primarily to produce commercial fertilizers and detergents. Second, discharge from sewage treatment plants and runoff of commercial fertilizers can overload aquatic ecosystems with phosphate ions. As in the case of nitrate ions, an excessive supply can explosive growth of blue-green algae and other aquatic plants that can disrupt life in aquatic ecosystems.

Упражнение 11.

Составьте 5 общих вопросов к тексту *Phosphorus cycle.*

Упражнение 12.

(Парная работа) Ответьте на вопросы, составленные в упражнении 11.

Lesson 2

Упражнение 1.

Попытайтесь вспомнить, что Вам известно о круговороте азота.

Подумайте и приведите 10–15 слов, которые могут встретиться в тексте.

Прочитайте и переведите текст.

Nitrogen cycle

Living things need nitrogen to manufacture proteins. Thus the growth of many plants can be limited by a lack of nitrogen available from the soil. Too little nitrogen can also cause malnutrition in people, because many of the body's essential functions require nitrogen-containing molecules such as proteins, DNA, and some vitamins.

The nitrogen gas that makes up about 78% of the volume of the earth's atmosphere is useless to most plants and animals. Fortunately, nitrogen gas is converted into water-soluble ionic compounds containing nitrate ions, which are taken up by plant roots as part of the nitrogen cycle. This nitrogen fixation – that is, the conversation of atmospheric nitrogen gas into forms useful to plants – is accomplished by (1) soil bacteria; (2) rhizobium bacteria living in small swellings; (3) blue-green algae in water and soil; (4) lightning, which converts nitrogen gas and oxygen gas in the atmosphere to forms that return to the earth as nitrate ions in rainfall and other types of precipitation.

Plants convert nitrates obtained from soil water into large, nitrogen-containing molecules such as the proteins and nucleic acids necessary for life and good health. Animals get most of the proteins and other nitrogen-containing molecules they need by eating plants or other animals that have eaten plants. When plants and animals die, decomposers break down the nitrogen-containing molecules into ammonia gas and water-soluble salts containing ammonium ions. Other specialized groups of bacteria then convert these forms of nitrogen back into nitrate ions in the soil and into nitrogen gas, which is released to the atmosphere to begin the cycle again.

Human beings intervene in the nitrogen cycle in several important ways. First, large quantities of NO and NO_2 are added to the atmosphere when fossil fuels are burned in power plants and vehicles. These oxides of nitrogen can react with other chemicals in the atmosphere

under the influence of sunlight to form photochemical smog and nitric acid, a major component of acid deposition, commonly known as acid rain. Second, nitrogen gas and hydrogen gas are converted by an industrial process into ammonia gas, which is then converted to ammonium compounds used as commercial fertilizer. Third, mineral deposits of compounds containing nitrate ions are mined and used as commercial fertilizers. Fourth, excess nitrate ions are added to aquatic ecosystems via the runoff of animal wastes from livestock feedlots, the runoff of commercial nitrate fertilizers from cropland, and the discharge of untreated and treated municipal sewage. This excess supply of nitrate plant nutrients can stimulate extremely rapid growth of algae and other aquatic plants, which can deplete the water of dissolved oxygen gas and cause massive fish kills.

Упражнение 2.

Составьте 5 специальных вопросов к тексту *Nitrogen cycle.*

Упражнение 3.

(Парная работа) Ответьте на вопросы, составленные в упражнении 2.

Упражнение 4.

Выберите из текста *Nitrogen cycle* 10–15 ключевых слов. Какие из Ваших предположений оправдались?

Упражнение 5.

Определите, к каким частям речи относятся выбранные Вами слова.

Упражнение 6.

Найдите в тексте *Nitrogen cycle* примеры этих частей речи.

v.	n.	adj.	adv.	prep.

Упражнение 7.

Используя суффиксы, образуйте глаголы или существительные и заполните пропуски в предложениях*: ~(at)ion , ~sion, ~ise.*

Примеры*: to vary – variation; to divide – division; character – to characterise.*

Verbs	*Nouns*
1. It is cheaper to **regulate** the temperature automatically.	Automatic temperature ... is more economical.
2. If gases … very rapidly cryogenic temperatures are attained.	Rapid **expansion** of the gases produces temperatures of below 120 Kelvin.
3. The committee was set up to **standardise** civil aviation procedures.	His job involves the … of aviation safety procedures.
4. People get old because the body … genetic damage.	Ageing is a result of the **accumulation** of genetic damage.
5. The first atomic bomb **exploded** on August 6, 1945.	80,000 people were killed in the Hiroshima …
6. The astronauts are provided with a 14-day supply of **pressurised** oxygen.	The oxygen supply is stored under …
7. Solar energy is … from hydrogen.	The generation of solar energy involves the **conversion** of hydrogen.
8. Heat losses can be … by thermal protection.	Efficient **insulation** reduces heat losses to a minimum.
9. It was necessary **to extend** the research facilities	Because of the increase in staff, an … had to be built

Упражнение 8.

В тексте *Nitrogen cycle* найдите слова с суффиксами *~(at)ion, ~sion, ~ise*.

Упражнение 9.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний:

1. lack of nitrogen	a. растворимые в воде соли
2. essential functions	b. быстрый рост
3. make up	c. азотная кислота
4. plant roots	d. сине-зеленые водоросли
5. rapid growth	e. жизненно важные функции
6. blue-green algae	f. электростанции
7. nucleic acids	g. городские сточные воды
8. water-soluble salts	h. фотохимический смог
9. power plants	i. промышленные (химические) удобрения
10. nitric acid	j. корни растений
11. photochemical smog	k. составлять
12. commercial fertilizers	l. недостаток азота
13. municipal sewage	m. нуклеиновые кислоты

Упражнение 10.
Прочитайте текст. (Контрольное время – 5 минут)
Слова, которые встретятся в тексте:
conventional removal – стандартное удаление;
reside in – возлагаться;
replenish – наполнять.

Nitrification is the biological oxidation of ammonia with oxygen into nitrite followed by the oxidation of these nitrites into nitrates. Degradation of ammonia to nitrite is usually the rate limiting step of nitrification. Nitrification is an important step in the nitrogen cycle in soil. This process was discovered by the Russian microbiologist, Sergei Winogradsky.

Nitrifying organisms are chemoautotrophs, and use carbon dioxide as their carbon source for growth.

Nitrification also plays an important role in the removal of nitrogen from municipal wastewater. The conventional removal is nitrification, followed by denitrification. The cost of this process resides mainly in aeration (bringing oxygen in the reactor) and the addition of an external carbon source (e.g. methanol) for the denitrification.

Together with ammonification, nitrification forms a mineralisation process which refers to the complete decomposition of organic materi-

al, with the release of available nitrogen compounds. This replenishes the nitrogen cycle.

Упражнение 11.

Ответьте на следующие вопросы, исходя из информации в тексте из упражнения 10:

1. Что такое нитрификация?
2. Где нитрификация играет важную роль?
3. За что отвечает процесс минерализации?

Упражнение 12.

Выпишите 10 ключевых слов из текста в упражнении 10.

Упражнение 13.

Найдите в тексте упражнения 10 слова с суффиксами *~(at)ion, ~sion, ~ise* и переведите их.

Упражнение 14.

Письменно переведите текст. (Контрольное время – 15 минут)

Wastewater

Onsite sewage facilities such as septic tanks and holding tanks release large amounts of nitrogen into the environment by discharging through a drainfield into the ground. Microbial activity consumes the nitrogen and other contaminants in the wastewater. However, in certain areas the soil is unsuitable to handle some or all of the wastewater, and as a result, the wastewater with the contaminants enters the aquifers. These contaminants accumulate and eventually end up in drinking water. One of the contaminants concerned about the most is nitrogen in the form of nitrates. A nitrate concentration of 10 ppm or 10 milligrams per liter is the current EPA (Environmental Protection Agency) limit for drinking water and typical household wastewater can produce a range of 20-85 ppm (milligrams per liter).

Lesson 3

Упражнение 1.

Ниже приводятся первые предложения 6 абзацев текста. Какие выводы Вы можете сделать о содержании текста?

The source of the radiant energy that sustains all life on earth is the sun.
The sun is a gigantic gaseous fireball composed mostly of hydrogen and helium gases.
Each type of radiant or electromagnetic radiation can be viewed as a wave.
About 34% of incoming solar radiation is reflected back to space.
Most of the incoming radiation not reflected away is degraded into longer-wavelength heat.
Concern is growing that human activities affect global climate patterns…

Упражнение 2.

Прочитайте и переведите текст. Проверьте правильность Ваших предположений.

Energy flow in the biosphere

The source of the radiant energy that sustains all life on earth is the sun. It lights and warms the earth and provides energy used by green plants to synthesise the compounds that keep them alive and serve as food for almost all other organisms. Solar energy also powers the biogeochemical cycles and drives the climate and weather systems that distribute heat and fresh water over the earth's surface.

The sun is a gigantic gaseous fireball composed mostly of hydrogen and helium gases. Temperatures in its inner core reach 30 million degrees Fahrenheit, and pressures there are so enormous that the hydrogen nuclei are compressed and fused to form helium gas. This thermonuclear or nuclear fusion, reaction taking place at the center of the sun continually releases massive amounts of energy, which pass through a thick zone of hot gases surrounding the inner core and eventually reach the surface. There the energy is radiated into space as a spectrum of heat, light, and other forms of radiant energy that travel outward in all

directions through space at a speed of 300,000 kilometers (186,000 miles) per hour.

Each type of radiant or electromagnetic radiation can be viewed as a wave with different wavelengths: the distance between the crests of one wave and the next. The longer the wavelength, the lower the energy content of a wave of radiant energy. This explains why the lower-energy, longer-wavelength types of radiant energy are not harmful to most living organisms, whereas the higher-energy, shorter-wavelength types are forms of ionizing radiation harmful to most organisms. Fortunately, most of these harmful forms of radiant energy from the sun are absorbed by molecules of ozone in the upper atmosphere and water vapour in the lower atmosphere. Without this screening effect, most life on earth could not exist.

About 34% of incoming solar radiation is reflected back to space by clouds, chemicals, and dust in the atmosphere and by the earth's surface. Most of the remaining 66% warms the atmosphere and land, evapourates water and cycles it through the biosphere, and generates winds; a tiny fraction (0.023%) is captured by green plants and used to make glucose essential to life.

Most of the incoming radiation not reflected away is degraded into longer-wavelength heat, or far-infrared radiation, in accordance with the second law of energy, and flows into space. The amount of energy returning to space as heat is affected by the presence of molecules such as water, carbon dioxide, methane, and ozone and by some forms of solid particulate matter in the atmosphere. These substances, acting as gatekeepers, allow short-wavelength radiant energy from the sun to pass through the atmosphere and back into space, but they absorb and reradiate some of the resulting longer-wavelength heat (far-infrared radiant energy) back toward the earth's surface.

Concern is growing that human activities affect global climate patterns by disrupting the rate at which incoming solar energy flows through the biosphere and returns to space as longer-wavelength heat. For example, according to some scientists, increases in the average levels of carbon dioxide in the earth's atmosphere, due primarily to the burning of fossils fuels and land clearing, may trap increasing amounts of far-infrared radiation that otherwise would escape into space, thus raising the average temperature of the atmosphere.

Упражнение 3

Определите подлежащее и сказуемое в каждом предложении первого абзаца текста *Energy flow in the biosphere.*

Упражнение 4.

Найдите в тексте *Energy flow in the biosphere* примеры этих частей речи.

v.	n.	adj.	adv.	prep.

Упражнение 5.

Прочитайте следующие слова и определите их соответствия в русском языке:

gigantic, spectrum, gaseous, helium, solar, reaction, biosphere, distance, massive, zone, kilometer, portion, substance, electromagnetic, energy, ozone, effect.

Упражнение 6.

Заполните пропуски, используя суффиксы*: ~ment, ~th, ~ness, ~en.*

Adjectives	*Nouns*	*Verbs*
1. The road is not *wide* enough.	The main problem is the … of the road.	Why don't they … the road?
2. We need better *measuring* techniques.	All the … were wrong.	We require techniques to … more accurately.
3. A lack of vitamins can have wide-*ranging* effects.	The … of potential diseases is considerable.	Lack of vitamins causes illnesses which … from goitre to anaemia
4. Cotton is a textile with *short* fibres.	It is cheap because of the … of the fibres.	Genetically modified cotton can … the growing season.
5. There is a *weak* attractive force between the molecules.	Because of the … of attraction the molecules can be separated.	Raising the temperature … the molecular attraction.
6. The deluxe model is well-*equipped.*	The car has got first class … .	It has been … with the latest gadgets.

7. When the eye becomes *red*, it is a symptom of bacterial infection.	… of the eye is a symptom of conjunctivitis.	The eye … as the bacteria spread.
8. How … is a horse?	The … of a horse can attain roughly 1,000 kg.	A horse can *weigh* almost 1,000 kg.

Упражнение 7.

Прочитайте текст и найдите ответы на следующие вопросы:

1. Из каких частей состоит биосфера?
2. Что такое экосистема?
3. Что включает в себя экосистема?
4. Откуда берется энергия для жизни?

(Контрольное время – 7 минут)

Biosphere

The biosphere, also called the ecosphere, is the natural environment of living organisms and is the complex biological epidermis of the Earth whose dimensions are not precisely defined. It consists of the surficial part of the lithosphere, a lower part of the atmosphere, and the hydrosphere. Several ecosystems have been developed within the biosphere. Each ecosystem is a fundamental division of the total environment consisting of living organisms in a given area and having a balanced cycling of chemical elements and energy flow.

Among the principal resources of which man disposes, are terrestrial ecosystems consisting of soil and water, and associated animal and plant life. Ecosystems are functional environmental units, having balanced cycles of chemical elements, organic materials and energy flow. There is a homeostatic interrelationship between the nonliving media (abiotic compartments) and the living organisms (biotic compartments).

However, a significant part of the ecosystems has already been considerably modified by humans, and these processes will continue.

The energy for life is derived from the radiant energy of the sun, which drives the chemical reaction of photosynthesis. The other sources of energy, e.g., geothermal, gravitation, and electrical, are of negligible importance in the total energy flow, but may determine specific conditions of some ecosystems.

Упражнение 8.

Выберите из текста в упражнении 7 10–15 основных, с точки зрения смысловой нагрузки, слов (ключевые слова). Определите, к каким частям речи они относятся.

Упражнение 9.

Письменно переведите текст. (Контрольное время – 30 минут)

Nuclear fusion

In nuclear physics and nuclear chemistry, nuclear fusion is the process by which multiple like-charged atomic nuclei join together to form a heavier nucleus. It is accompanied by the release or absorption of energy, which allows matter to enter a plasma state.

The fusion of two nuclei with lower mass than iron (which, along with nickel, has the largest binding energy per nucleon) generally releases energy while the fusion of nuclei heavier than iron absorbs energy; vice-versa for the reverse process, nuclear fission. In the simplest case of hydrogen fusion, two protons have to be brought close enough for their mutual electric repulsion to be overcome by the nuclear force and the subsequent release of energy.

It takes considerable energy to force nuclei to fuse, even those of the lightest element, hydrogen. This is because all nuclei have a positive charge (due to their protons), and as like charges repel, nuclei strongly resist being put too close together. Accelerated to high speeds (that is, heated to thermonuclear temperatures), they can overcome this electromagnetic repulsion and get close enough for the attractive nuclear force to be sufficiently strong to achieve fusion. The fusion of lighter nuclei, which creates a heavier nucleus and a free neutron, generally releases more energy than it takes to force the nuclei together; this is an exothermic process that can produce self-sustaining reactions.

Блок 8
POLLUTION

Lesson 1

Упражнение 1.

Прочитайте слова и словосочетания и попробуйте догадаться, о чем пойдет речь в следующем тексте:

pollutants, atmosphere, troposphere, air pollution, damage, death, substance, problem, emission, outdoor, human activity, harmful, chemicals, chemical reactions.

Упражнение 2.

Прочитайте и переведите текст.

Types and sources of outdoor air pollution

As clean air moves across the earth's surface, it collects additional loads of chemicals produced by natural events and human activities. Once in the troposphere, potential air pollutants mix vertically and horizontally and often react chemically with each other or with natural components of the atmosphere. When the concentration of a normal component of air or a new chemical added to or formed in the air builds up to the point of causing harm to humans, other animals, vegetation, or materials such as metals and stone, that chemicals is classified as an air pollutant. Worldwide, each year air pollution causes at least 150,000 premature deaths, causes or aggravates debilitating respiratory diseases for tens of millions of people, and result in at least $100 billion in damages to crops, trees, buildings, and other objects.

Although there are hundreds of potential air pollutants, most air pollution results from six major classes of substances. About 90% of all air pollution problems are caused by five groups of pollutants: carbon monoxide, nitrogen oxides, sulfur oxide, volatile organic compounds (mostly hydrocarbons), and suspended particulate matter. Natural sources of air pollutants include forest fires started by lightning, pollen dispersal, wind erosion of soil, volcanic eruptions, evaporation of volatile organic compounds from leaves, bacterial decomposition of organic matter, sea spray (sulfate particles), and natural radioactivity (radon-

222 gas from deposits of uranium, phosphate, and granite). But emissions from natural sources are dispersed throughout the world and rarely reach concentrations high enough to cause serious damage. Exceptions include massive injections of sulfur dioxide and suspended particulate matter (SPM) from volcanic eruptions and build up of radon-222 gas inside buildings. Most potential pollutants are added to the troposphere as result of human activities: mainly the burning of fossil fuels in power and industrial plants (stationary sources), and in motor vehicles (mobile sources).

Air pollutants can be classified as either primary or secondary. A primary air pollutant is a harmful chemical that directly enters the air as result of natural events or human activities. A secondary air pollutant is a harmful chemical that forms in the air because of a chemical reaction between two or more air components.

Упражнение 3.

Подберите соответствующий заголовок к каждому абзацу:

Primary and Secondary Air Pollutants;

Major Types of Outdoor Air Pollutants;

Sources of Outdoor Air Pollutants.

Упражнение 4.

Прочитайте следующие слова и определите их соответствия в русском языке:

type, collect, chemical, natural, activity, troposphere, vertically, horizontally, reaction, component, material, classify, respiratory, result, potential, problem, organic, bacterial, radioactivity, concentration, volcanic, motor.

Упражнение 5.

Найдите в тексте примеры этих частей речи.

v.	n.	adj.	adv.	prep.

Упражнение 6.

Составьте 5 вопросов к первому абзацу текста *Types and sources of outdoor air pollution.*

Упражнение 7.

(Парная работа) Ответьте на вопросы в упражнении 6.

Упражнение 8.

Найдите подлежащее в каждом предложении второго абзаца текста *Types and sources of outdoor air pollution.*

Упражнение 9.

Подберите определение к выделенному слову и затем вставьте соответствующий предлог*: in of up out for on.*

1. Each year air pollution **result** … at least $100 billion in damages to crops, trees, buildings etc. 2. When visibility is reduced, airports **rely …** radar control. 3. In 1830, Babbage designed a machine to **carry …** complex arithmetical calculations. 4. A protein may **consist …** several polypeptide chains held together by weak molecular bonds. 5. In 1937, four Soviet scientists **set …** temporary scientific stations on drifting icebergs in the Arctic. 6. Chemists can **work …** the number of carbon atoms from the weight of the object. 7. Testosterone is **involved …** the development of secondary sex characteristics such as the growth of body hair, and changes in the larynx. 8. It is the ability to use the Sun and the stars to navigate which **accounts …** the migration of birds. 9. The level of pH **depends …** the strength of the acid.	a. to do / to perform b. to be made of/ formed from c. to be determined by d. to calculate / find the solution e. to create / establish f. to use because you have confidence g. to be linked / a necessary part of h. to provide an explanation i. to cause

Упражнение 10. Прочитайте текст и найдите ответы на следующие вопросы. (Контрольное время – 5 минут):

1. Почему воздух в помещении сегодня намного чище?
2. Что обнаружили ученые?
3. Что могут вызывать воздушные загрязнители?
4. Какой загрязнитель представляет наибольшую угрозу?

Indoor air pollution

High concentrations of air pollutants can also build up indoors, where people spend 85% to 90% of their time, and in other enclosed spaces such as underground mines, where air is slowly replenished. Indoor air today generally much cleaner than that found decades ago, when most houses and other buildings were heated with leaky coal-burning furnaces, but there is still cause for concern. In recent years, scientists have found that the air inside some homes, schools, and office buildings is more polluted and dangerous than outdoor air on a smoggy day. Air pollutants found in buildings produce dizziness, headaches, coughing, sneezing, burning eyes, and flulike symptoms in many people. Air pollutants can accumulate in any buildings. But levels tend to be higher in energy-efficient, relatively airtight houses that do not use air-to-air heat exchangers to bring in sufficient fresh air. According to the EPA and public health officials, the most serious indoor air pollution threat is from radioactive radon-222.

Упражнение 11.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *Indoor air pollution:*

1. burning eyes	a. угольные печи
2. coal-burning furnaces	b. симптомы заболевания, похожего на грипп
3. flulike symptoms	c. герметичные (воздухонепроницаемые) дома
4. according to	d. высокие концентрации
5. airtight houses	e. жжение в глазах
6. high concentrations	f. теплообменники
7. build up	g. организаторы здравоохранения
8. cause for concern	h. постепенно накапливаться
9. heat exchangers	i. согласно
10. public health officials	j. причина для беспокойства

Упражнение 12.

Найдите в каждом предложении текста *Indoor air pollution* подлежащее и сказуемое. Определите время и залог сказуемого.

Упражнение 13.

Письменно переведите текст. (Контрольное время – 25 минут)

Control of indoor air pollution

Despite the seriousness of indoor air pollution, Congress and state legislatures have been reluctant to establish mandatory indoor air quality standards. Part of the problem with monitoring and controlling indoor air pollution is that there are over a hundred million homes and buildings involved. In addition, many home and buildings owners would resent having their indoor air tested and being required to reduce excessive pollution levels, even if their indoor air was making them sick or threatening them and other family members with premature death.

One way to control indoor air pollution is to install air-to-air heat exchangers, which maintain a flow of fresh air without causing major heating or cooling losses. A study showed that indoor levels of formaldehyde and several other toxic gases can also be sharply reduced by house plants.

Lesson 2

Упражнение 1.

Прочитайте заголовок приводимого ниже текста. Подумайте, о чем в нем может идти речь. Приведите 10–15 слов, которые могут, с Вашей точки зрения, встретиться в тексте.

Прочитайте и переведите текст.

Pollution

Any change in the physical, chemical, or biological characteristics of the air, water, or soil that can affect the health, survival, or activities of human beings or other forms of life in an undesirable way is called pollution. Pollution does not have to cause physical harm; pollutants such as noise and heat may cause injury but more often cause psychological distress, and aesthetic pollution such as foul odors and unpleasant sights offend the senses. People, however, may differ in what they consider to be a pollutant, on the basis of their assessment of benefits and risks to their health and economic well-being. For example, visible and invisible chemicals spewed into the air or water by an industrial plant might be harmful to people and other forms of life living nearby. However, if the installation of expensive pollution controls forced the plant to shut down, workers who would lose their jobs might feel that the risks from polluted air and water are minor weighed against the benefits of profitable employment. The same level of pollution can also affect two people quite differently – some forms of air pollution might be a slight annoyance to a healthy person but life-threatening to someone with emphysema. As the philosopher Georg Hegel pointed out, the nature of tragedy is not the conflict between right and wrong but between right and right.

As long as they are not overloaded, natural processes or human-engineered systems (such as sewage treatment plants) can biodegrade, or break down, some types of pollutants to an acceptable level or form. Pollutants can be classified as being rapidly biodegradable (such as animal and crop wastes), slowly biodegradable (such as DDT and PCBs), and nonbiodegradable (such as toxic mercury and lead compounds and some radioactive substances). Polluting substances can enter the environment naturally or through human activities. Most natural pollution is dispersed over a large area and is often diluted or degraded to harmless

levels by natural processes. In contrast, the most serious human pollution problems occur in or near urban and industrial areas, where large amounts of pollutants are concentrated in relatively small volumes of air, water, and soil. Furthermore, many pollutants from human activities are synthetic (human-made) chemicals that are slowly biodegradable or nonbiodegradable.

Determining the amount of a particular pollutant that can cause a harmful or undesirable effect in human beings or other organisms is a difficult scientific problem. The amount of a chemical or pollutant in a given volume of air, water, or other medium is called its concentration. Concentrations of pollutants are often expressed as parts per million (ppm) or parts per billion (ppb) – the number of parts of a chemical or pollutant found in 1 million or 1 billion parts of air, water, or other medium. Although 1 ppm and 1 ppb represent very small concentrations for some organisms, with some pollutants they represent dangerous levels. During a lifetime an individual is exposed to many different types and concentrations of potentially harmful pollutants. The scientific evidence correlating a particular harmful effect to a particular pollutant is usually statistical or circumstantial – as is most scientific evidence. For example, so far no one has been able to show which specific chemicals in cigarette smoke cause lung cancer; however, smoking and lung cancer are causally linked by an overwhelming amount of statistical evidence from more than 32,000 studies. Another complication is that certain pollutants acting together can cause a harmful effect greater than the sum of their individual effects. This phenomenon is called a synergistic effect. For example, asbestos workers, already at a higher-than-average risk of lung cancer, greatly increase that risk if they smoke, because of an apparent synergistic effect between tobacco smoke and tiny particles of asbestos inhaled into the lungs. Testing all the possible synergistic interactions among the thousands of possible pollutants in the environment is prohibitively expensive and time-consuming, even for their effects on one type of plant or animal.

Упражнение 2.

Подберите соответствующий заголовок к каждому абзацу.

What is Pollution?

Determining Harmful Levels of Pollutants.

Types and Sources of Pollutants.

Упражнение 3.

Выберите из текста *Pollution* 10–15 ключевых слов. Какие из Ваших предположений оправдались?

Упражнение 4.

Определите, к каким частям речи относятся выбранные Вами слова.

Упражнение 5.

Прочитайте следующие слова и определите их соответствия в русском языке:

Physical, biological, characteristics, forms, psychological, basis, risk, economic, industrial, installation, person, philosopher, process, classify, urban, effect, concentration, million, organism, statistical, sum, individual, type, radioactive.

Упражнение 6.

Составьте 5 общих вопросов к 1 абзацу текста *Pollution.*

Упражнение 7.

(Парная работа) Ответьте на вопросы, составленные в упражнении 6.

Упражнение 8.

Выберите правильный ответ:

1. The device enables temperatures to be monitored, … improving the safety margin.	a. thereby b. nevertheless c. namely d. e.g.
2. A new technique, … the infra-red camera, means that dust surrounding new stars can be penetrated.	a. whereas b. namely c. besides d. for instance
3. Superconducting, … when materials lose all resistance, will boost computer performances.	a. thus b. obviously c. besides d. that is to say

4. Programmable electronic systems are more reliable … , they can be used to handle radio-active material.	a. whereas b. such as c. moreover d. in other words
5. Computers can process data extremely fast. … this, they have several serious drawbacks.	a. in spite of b. whereas c. however d. moreover
6. The new engine is far more efficient. … more work is required to reduce noise levels.	a. nevertheless b. whereas c. i.e. d. besides
7. The presence of high concentrations of elements that are rarely found on Earth, … iridium, suggests there was a meteorite impact at that spot.	a. on the whole b. moreover c. such as d. that is to say
8. The data is stored on hard disk, … it is easily accessible.	a. actually b. whereas c. e.g. d. hence
9. Applicants for the job should speak at least one other European language … French.	a. obviously b. besides c. moreover d. actually
10 … , in the initial stages there were minor problems to be overcome, but from then on, the prototypes were perfectly reliable.	a. besides b. as a rule c. namely d. despite

Упражнение 9.

Прочитайте текст и найдите ответы на следующие вопросы. (Контрольное время – 10 минут):

1. От чего зависит общее загрязнение выбранной области?
2. Что значит перенаселенность?
3. К чему приводит перенаселенность в слаборазвитых странах?
4. Где встречается перенаселенность 2 типа и что это такое?

The roots of environmental degradation and pollution

According to one simple model, the total environmental degradation and pollution or environmental impact of population in a given area depends on three factors: (1) the number of people; (2) the average amount of resources each person uses; and (3) the environmental degradation and pollution resulting from each unit of resource used.

In general, overpopulation occurs when the people in a country, a region, or the world are using nonrenewable and renewable resources to such an extent that the resulting degradation or depletion of the resource base and pollution of the air, water, and soil are impairing their life-support systems.

The type known as people overpopulation exists where there are more people than the available supplies of food, water, and other vital resources can support, or where the rate of population growth so exceeds the rate of economic growth that an increasing number of people are too poor to grow or buy sufficient food, fuel, and other vital resources. In this type of overpopulation, population size and the resulting environmental degradation of potentially renewable soil, grasslands, forests, and fisheries tend to be the most important factors determining the total environmental impact. In the world's poorest LDCs, people overpopulation results in premature death for 12 million to 20 million human beings each year and bare subsistence for hundreds of millions more – a situation that many fear will worsen unless population growth is brought under control and improved resource management is used to restore degraded renewable resource bases.

Affluent and technologically advanced countries such as the United States, the Russian Federation, and Japan are said by some to have a second type of overpopulation, known as consumption overpopulation. It is based on the fact that without adequate pollution and land use controls, a small number of people using resources at a high rate produces more pollution and environmental degradation than a much larger number of people using resources at a much lower rate. With this type of overpopulation, high rates of resource use per person and the resulting high levels of pollution per person tend to be the most important factors determining overall environmental impact.

Упражнение 10.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *The roots of environmental degradation and pollution*:

1. average amount	a. невозобновляемые ресурсы
2. environmental degradation	b. относительная важность
	c. рост населения
3. nonrenewable resources	d. контроль землепользования
4. result in	e. приводить к
5. relative importance	f. основываться на
6. supply of food	g. воздействия на окружающую среду
7. population growth	h. среднее количество
8. be based on	i. снабжение продовольствием
9. land use control	j. ухудшение состояния окружающей среды
10. environmental impact	

Упражнение 11.

(Парная работа) Перескажите содержание текста *The roots of environmental degradation and pollution* в 10 предложениях.

Упражнение 12.

Письменно переведите текст. (Контрольное время – 30 минут)

Pollution and environmental degradation are intensified not only by population size but also by population distribution. The most severe air and water pollution problems usually occur when large numbers of people are concentrated in urban areas. Conversely, spreading people out can have a devastating effect on potentially renewable soil, forest, grassland, and recreational resources. War also has a devastating environmental impact.

Some scientific and technological developments, such as the automobile and phosphate detergents, create new environmental problems or aggravate existing ones. Other scientific and technological developments can help solve various environmental and resource problems. Substitutes have been developed for many scarce resources. Light bulbs, for example, have replaced whale oil in lamps, thus helping protect the world's rapidly diminishing population of whales from extinction. Unnecessary resource waste has been reduced. For example, more

energy is recovered from a ton of coal than in the past, and processes to control and clean up many forms of pollution have been developed.

One major attempt to use technology wisely is the increased global emphasis on appropriate technology. Appropriate technology is usually small, simple, decentralized, and inexpensive to build and maintain, and it usually utilizes locally available materials and labor. Supporters of appropriate technology recognize that it is not a cure for all our environmental problems but believe that its increasing use is an encouraging trend that should be nurtured.

Economic, political, and ethical factors are also involved. We can manipulate the economic system to control pollution, environmental degradation, and resource waste by making such practices unprofitable (in free-market economies) or illegal (in centrally controlled).

Lesson 3

Упражнение 1.

Попытайтесь вспомнить, что Вам известно о смоге.

Подумайте и приведите 10–15 слов, которые могут встретиться в тексте.

Прочитайте и переведите текст.

Industrial and photichemical smog

Industrial Smog. Various groups of air pollutants found in the air over cities can be classified as either industrial smog or photochemical smog. Although both types of smog are found to some degree in most urban areas, one type often predominates during at least part of the year as a result of differences in climate and major sources of air pollution.

Industrial smog consists mostly of a mixture of sulfur dioxide and SPM, including a variety of solid particles and droplets of sulfuric acid formed from some of the sulfur dioxide. These substances form a grayish haze, explaining why cities where this type of smog predominates are sometimes called gray-air cities. This type of air pollution tends to predominate during the winter (especially in the early morning) in older, heavily industrialized cities like London, Chicago, Philadelphia, St. Louis, and Pittsburgh, which typically have cold, wet winters and depend heavily on coal and oil for heating, manufacturing, and producing electric power.

Photochemical Smog: Cars + Sunlight = Tears. A combination of primary pollutants such as carbon monoxide, nitric oxide, and hydrocarbons and secondary pollutants such as nitrogen dioxide, nitric acid, ozone, hydrogen peroxide, peroxacyl nitrates (PANs), and formaldehyde, produced when some of the primary pollutants interact under the influence of sunlight, is called photochemical smog. Cities in which photochemical smog predominates usually have sunny, warm, dry climates. They are generally newer cities with few polluting industries and large numbers of motor vehicles, which are the major source of air pollution. Examples include Los Angeles, Denver, Salt Lake City, the USA, as well as Sydney, Australia; Mexico City, Mexico; and Buenos Aires, Argentina. The worst episodes from this type of smog tend to occur in summer months between noon and 4 p.m.

The first step in the formation of photochemical smog occurs during the early morning traffic rush hours, when NO from automobiles

builds up and reacts with O_2 to produce NO_2, a yellowish-brown gas with a pungent, choking odor. This gas produces a characteristic brownish haze, explaining why cities such as Los Angeles, where photochemical smog predominates, are sometimes called brown-air cities. Then, as the sun rises, its ultraviolet rays cause a series of complex chemical reactions that produce the other components of this type of smog. The mere traces of ozone, PANs, and aldehydes that build up to their peak levels around noon and in the early afternoon on a sunny day can irritate people's eyes and respiratory tracts. During the summer months most industrial smog cities also experience photochemical smog.

Local Climate, Topography and Smog. The frequency and severity of industrial and photochemical smog in an urban area depend on local climate and topography, density of population and industry, and major fuels used in industry and for heating and transportation. In areas with high average annual precipitation, rain and snow help cleanse the air of pollutants. Winds also help sweep pollutants away and bring in fresh air. However, hills and mountains tend to reduce the flow of air in valleys below and allow pollutant levels to build up at ground level. Buildings in cities also slow wind speed and impede dilution and removal of pollutants.

During the day the sun warms the air near the earth's surface. Normally, this heated air expands and rises during the day, diluting low-lying pollutants and carrying them higher into the troposphere. Air from surrounding high-pressure areas then moves down into the low-pressure area created when the hot air rises. This continual mixing of the air helps keep pollutants from reaching dangerous levels in the air near the ground.

But sometimes a layer of dense, cool air is trapped beneath a layer of less dense, warm air in an urban basin or valley. This is called a temperature or thermal inversion. In effect, a warm-air lid covers the region and prevents pollutants from escaping in upward-flowing air currents. Usually these inversions last for only a few hours, but sometimes they last for several days when a high-pressure air mass stalls over an area. When this happens, air pollutants at ground level accumulate to harmful and even lethal levels. Most air pollution disasters—such as those in London and in Donora, Pennsylvania, occurred during lengthy thermal inversions during fall or winter in industrial smog areas.

Thermal inversions occur more often and last longer over towns or cities located in valleys surrounded by mountains, on the leeward sides of mountain ranges, and near coasts. A city with several million people and automobiles in an area with a sunny climate, light winds, mountains on three sides, and the ocean on the other possesses the ideal conditions for photochemical smog worsened by frequent thermal inversions. This describes the Los Angeles basin, which experiences almost daily inversions, many of which are prolonged during the summer months.

Упражнение 2.

Найдите в каждом предложении 1 абзаца текста *Industrial and photichemical smog* подлежащее и сказуемое. Определите время и залог сказуемого.

Упражнение 3.

В правой колонке найдите русские эквиваленты следующих английских словосочетаний из текста *Industrial and photichemical smog*:

1. air pollutants	a. главный источник
2. industrial smog	b. сероватый туман
3. urban areas	c. промышленный смог
4. grayish haze	d. городские районы
5. sulfur dioxide	e. первичные загрязнители
6. primary pollutants	f. диоксид серы
7. carbon monoxide	g. фотохимический смог
8. photochemical smog	h. час пик
9. rush hour	i. загрязнители воздуха
10. major source	j. угарный газ

Упражнение 4.

(Парная работа) Составьте 10 предложений с словосочетаниями из упражнения 3.

Упражнение 5.

Прочитайте текст. (Контрольное время – 9 минут)

Acid deposition

One way to decrease ground-level air pollution from sulfur dioxide, SPM, and nitrogenoxides when coal and oil are burned in electric

power plants, metal smelters, and other industrial plants is to discharge these emissions from smokestacks tall enough to pierce the thermal inversion layer. Use of tall smokestacks in the United States, Canada, and western Europe has led to considerable reduction of ground-level pollution in many urban areas.

This approach, however, leads to increased levels of these pollutants and various secondary pollutants in downwind rural and urban areas. As emissions of sulfur dioxide and nitric oxide are transported over long distances by wind currents, they are chemically transformed into a variety of secondary pollutants such as nitrogen dioxide, droplets of sulfuric and nitric acids, and solid particles of sulfate and nitrate salts.

These chemicals fall or are washed out of the atmosphere onto downwind land and bodies of water. Wet deposition occurs when some of the suspended droplets of sulfuric acid and nitric acid return to the earth as acid rain or its variants, consisting of these acids and snow, sleet, hail, fog, or dew. Dry deposition occurs when solid particles of sulfate and nitrate salts and gases such as sulfur dioxide fall or are washed out of the atmosphere, usually near the original pollution sources. These deposited solids can then react with water in soil and bodies of water to form sulfuric and nitric acids. The combined wet and dry deposition of acids or acid-forming substances onto the surface of the earth is known as acid deposition. This phenomenon is commonly called acid rain, but this is a misleading term because these acids and acid-forming substances are deposited not only in rain but also in snow, sleet, fog, and dew and as dry particles and gas.

The relative levels of acidity and basicity of water solutions of substances are commonly expressed in terms of pH. The lower the pH value, the higher the acidity, with each whole-number decrease in pH representing a tenfold increase in acidity. Natural precipitation has an average pH value of 5.1 (with a range of 5.0 to 5.6 depending on location), caused when carbon dioxide and traces of natural sulfur and nitrogen compounds and organic acids in the atmosphere dissolve in atmospheric water. This slight acidity of natural precipitation helps water deposited on soil to dissolve minerals for use by plants and animals. It also deposits some sulfur and nitrogen used as plant nutrients.

However, deposition of acids and acid-forming substances with higher levels of acidity (pH values of 5.0 and less) than those in natural precipitation can damage materials; leach certain nutrients from soil;

and kill fish, aquatic plants, and microorganisms in lakes and streams. Acid deposition, in combination with other air pollutants such as ozone, sulfur dioxide, and nitrogen oxides, can damage trees, crops, and other plants. It can also affect human health.

Упражнение 6.
Составьте 10 вопросов к тексту *Acid deposition*.

Упражнение 7.
(Парная работа) Ответьте на вопросы упражнения 6.

Упражнение 8.
(Парная работа) Перескажите текст *Acid deposition* в объеме 10 предложений.

Упражнение 9.
Подберите определение модификаторам:

1. Typical	a. Quite exceptional - you just can't class it with the others
2. Efficient	b. Almost
3. Huge	c. A little more than nothing - but not much
4. Reliable	d. Could be more, could be less - not much precision here
5. Virtually	e. Within limits
6. To a certain extent	f. Completely, carefully and conscientiously
7. Thoroughly	g. Conforms totally to expectations - zero surprise
8. Roughly	h. The capitalist's dream - maximum work, minimum waste
9. Outstanding	i. All over the place – ubiquitous in fact
10. Widespread	j. Not just big – a macro-dimension
11. Basically	k. You can count on this – it will never let you down
12. Hardly any	i. To start at the beginning or, more accurately, to go right down to the foundations

Упражнение 10.
Вставьте модификаторы из упражнения 9 в предложения:
1. Farms are most … when they comprise a thousand hectares or more.
2. Although it has a … population, China has successfully reduced both fertility and mortality.

3. …, there are four types of language in Europe.
4. Historical records of earthquakes before the middle of the 18th century are not …
5. There is still … fear that genetically modified viruses might escape from the laboratory.
6. A human being requires … 3,000 calories a day.
7. Intra-species fighting can be observed in … all vertebrates.
8. Osteoporosis (thinning of the bones) is a … example of an age-related disease.
9. Military trainee pilots are very … prepared.
10. From a technological point of view, Concorde has been an … success.
11. There are … tigers left - they'll soon be extinct.
12. … , I agree with you.

Упражнение 11.

Переведите текст письменно. (Контрольное время – 20 минут)

Urban Heat Islands

In accordance with the second energy law, when energy is converted from one form to another, low-quality heat is added to the atmosphere. In the United States, energy use is so high that the average continuous heat load per person injected into the atmosphere is equivalent to that from a hundred 100-watt light bulbs.

The effect of all this atmospheric heating is evident in large cities and urban areas, which are typically like huge islands of heat surrounded by cooler suburban and rural areas, a climatic effect known as the urban heat island. This dome of heat helps trap pollutants, especially SPM, and creates a dust dome above urban areas. As a result, concentrations of SPM over urban-industrial areas may be a thousand times higher than those over rural areas. If wind speeds increase, this dust dome elongates downwind to form a dust plume that spreads the city's pollutants to rural areas and other urban areas tens to hundreds of miles away. As urban areas grow and merge into vast urban regions, the heat and dust domes from a number of cities can combine to form regional heat islands, which affect regional climates and prevent polluted air from being effectively diluted and cleansed.

Грамматический справочник

1. Употребление временных форм глагола в действительном залоге (Active Form) (на примере правильного глагола *to ask* – спрашивать)

Инфинитив Время	Simple (to ask)	Continuous (to be asking)	Perfect (to have asked)
Present	ask asks (he, she, it)	am asking is are	have asked has (he, she, it)
Past	asked	was asking were	had asked
Future	shall (I, we) ask will	shall be asking will	shall have asked will

Употребление временных форм глагола в страдательном залоге (Passive Form) to be + Participle II (в соответствующем времени)

Инфинитив Время	Simple (to be asked)	Continuous	Perfect (to have been asked)
Present	am is asked are	am is being asked are	have been asked has
Past	was asked were	was being asked were	had been asked
Future	shall (I, we) will be asked	–	Shall have been will asked

Тренировочные упражнения

Упражнение 1.

Переведите предложения, обращая внимание на время и залог сказуемого.

1. Elevation differences are always introducing temperature changes.
2. Closed isotherms separate the city from the general temperature field, and this condition has become known as the «urban heat island».

3. The differences between the urban and the rural area depend on the synoptic conditions.
4. Radiation is the physical process by which energy is emitted from a source in the form of electromagnetic waves.
5. The electromagnetic waves travel along straight paths until they hit objects from which they are partly reflected and partly absorbed.
6. For large-scale processes the pressure can be regarded as a measure of the weight of the atmosphere above a given level.
7. The temperature distribution is used to classify the various layers of the atmosphere.
8. The circumstances that produce the charge separation have not been fully understood.
9. Circulation systems are produced by changes of elevation, differences between land and water, differences in thermal properties of the ground.

Упражнение 2.

Переведите предложения, учитывая видовременную форму сказуемого.

1. An observer collects snow samples once a day.
2. The field of urban climatology has grown rapidly in recent years.
3. The winds blowing back towards the equator are moving from a region of slower eastward movement into the region of fastest movement.
4. Temperatures do not vary gradually from the tropics towards the poles.
5. Upon striking the ground, the water froze.
6. Positive current will flow from the upper cloud portion to the ionosphere.
7. The vast majority of thunderstorms over the tropics produce no rain.

Упражнение 3.

Определите время и залог сказуемого. Переведите предложения.

1. The radiation from the earth's surface is called terrestrial radiation.
2. Many tests have been performed with wind shielding.
3. Certain limited features of global climate can be studied by physical models.

4. Synoptic weather observations are done simultaneously everywhere on earth, in intervals of 3 hours.
5. The extent of snow cover was seen in satellite pictures.
6. Microwaves are reflected by raindrops and ice crystals.
7. If burning of fossil fuels is not limited the atmosphere's carbon dioxide will be doubled some time near the middle of the 21st century.

Упражнение 4.

Выберите правильную форму сказуемого (Active voice – Passive voice). Переведите предложения.

1. The mechanisms of air-mass modification (treat/are treated) separately.
2. Surface cooling (produces/is produced) a temperature inversion which greatly (limits/is limited) the vertical extent of the cooling,
3. The moisture (supplies/is supplied) from the underlying surface.
4. Ascent or descent of air (causes/is caused) adiabatic changes of temperature.
5. One approximate means of indirect measurement (bases/is based) on the moisture balance equation.
6. The technique (allows/is allowed) the determination of daily evapotranspiration amounts.
7. Potential evapotranspiration (calculates/is calculated) as the difference between precipitation and percolation.
8. The snow-covered source regions of these two air masses (lead/are led) to marked cooling of lower layers.

Упражнение 5.

Измените предложения из действительного в страдательный залог.

1. The atmosphere warms or cools the ocean.
2. Stratosphere absorbs energy from the incoming sunlight.
3. Interactions between land, sea, air, and ice affect the workings of the weather machine.
4. Different groups of scientists developed the General Circulation Models.
5. These models produce a variety of estimates.
6. Motor vehicles cause the air pollution.

Упражнение 6.

Переведите, обращая внимание на особенности перевода пассивных конструкции.

1. The modern scientific forecasts of weather can be fully relied upon.
2. Heat is radiated by the Sun to the earth, but the land, the sea, and the air are affected differently by this radiation.
3. We live at the bottom of an ocean of air, and our lives are influenced by the change and movement of this gas.
4. Single atoms of oxygen are seldom met with.
5. We were shown a number of experiments illustrating the presence of high-energy particles in the cosmic radiation.
6. The runoff from such glaciers is being utilized for different purposes, and as a consequence hydrologic investigations have been made or are being made in connection with these supplies.
7. Illinois was affected by the drought but to a lesser degree than the neighboring states.
8. The infiltration capacity is affected by antecedent precipitation.

Упражнение 7.

Переведите следующие предложения на русский язык.

1. Flood hazards are influenced by the terrain in other ways.
2. Severe floods are occasionally produced by intense rainstorms in summer.
3. Discharge measurements are made in several ways.
4. The downstream flow of a stream is checked by friction.
5. Percolation is favored by a slow, steady precipitation, pervious soil, and flat slopes.
6. The arte of percolation is also affected by the initial condition of soil.
7. The mean velocity of a stream can only be computed after the discharge itself has been ascertained.
8. Little reliance can be placed upon results obtained in this manner unless the characteristics of the two watersheds are identical.

Упражнение 8.

Поставьте глаголы-сказуемые следующих предложений в формы времени Past, Future Indefinite, а также в форму времени Present Perfect.

1. Evaporation attracts the interest of many scientists.
2. It is difficult to assess the reliability of the method.
3. The discharge is measured twice daily.

2. Значения слова *it*

Местоимение *it* имеет разные значения и выполняет различные функции в предложении. Оно может быть:

1) личным местоимением в именительном падеже. В этом случае на русский язык оно переводится местоимениями «он», «она», «оно». Например:

Many insects use the water surface as if it were solid. Многие насекомые используют водную поверхность как будто она твердая.

2) указательным местоимением со значением «это». Например:

It is the best option.
Это лучший способ.

3) формальным подлежащим в безличных предложениях; на русский язык не переводится. Например:

a) It is cold.
a) Холодно.
b) It is necessary to research this phenomenon.
б) Необходимо исследовать это явление.
c) It is desirable that the technology be improved.
в) Желательно, чтобы технология была усовершенствована.

4) частью усилительной конструкции **it is ... that**, перевод которой начинается словом “именно”. Например:

*It is this method of analysis **that** yielded best results.*
Именно этот метод анализа дал наилучшие результаты.

3. Значения слов *that и those*

Слова *that* и *those* употребляются:

1. Как указательные местоимения в значении «тот», «те». Например:

***That** method is more reliable than the old one.*
Тот метод надежнее, чем старый.

2. Как заместители ранее упомянутых существительных. В этом случае они часто употребляются с предлогом *of* и на рус-

ский язык переводятся теми существительными, которые **that** и **those** заменяют. Например:

*The air over the land becomes cooler than **that** over the water. Воздух над сушей становится холоднее воздуха над водой.*

3. **That** употребляется для присоединения придаточных предложений и переводится союзным словом который. Например:

The hydrologic problems in irrigation are similar to those in water supply. Гидрологические проблемы орошения аналогичны проблемам водоснабжения.

4. **That** употребляется для присоединения придаточных предложений и переводится союзом что. Например:

*It is well known **that** climates may be grouped as continental, marine or coastal. Хорошо известно, что климат бывает континентальным, морским и прибрежным.*

5. **That** употребляется как часть усилительной конструкции **It is ... that**. Например:

It is here, at Greenland Ranch, that a temperature of 134, the highest record in the United States was recorded. Именно здесь, на ранчо Гринленд, была зафиксирована температура 134, самая высокая из всех зарегистрированных в США.

6. **That** употребляется в предложениях типа ***It is necessary … that*** и переводится союзом *чтобы*. Например:

It is necessary that all data be prepared in time. Необходимо, чтобы все данные были подготовлены вовремя.

4. Значения слова *one*

Слово **one** может быть:

1) числительным «один». Например:

One of the most important tasks now is to determine the distribution of rain throughout the year.

Одна из самых важных задач сейчас заключается в том, чтобы определить распределение осадков в течение года.

2) заместителем ранее упомянутого существительного. В этом случае слово **one** не переводится или «восстанавливается» существительное, которое **one** заменяет. Например:

I don't like this method, let's use an other one. Мне не нравится этот метод, давайте используем другой (метод).

3) формальным подлежащим, если оно стоит перед глаголом в личной форме. В этом случае слово **one** не переводится. Например:

To construct a map one has to follow a number of more or less arbitrary rules.

Чтобы составить карту, необходимо использовать ряд более или менее произвольных правил.

Как формальное подлежащее слово **one** широко употребляется с модальными глаголами, где переводится следующим образом:

	must	
one	has to	нужно,
	is to	необходимо
one	should	
	ought to	нужно, следует
one	may	можно

Например:

One should know the difference between these two systems.

Необходимо понимать разницу между этими двумя системами.

Тренировочные упражнения

Упражнение 1.

Переведите следующие упражнения на русский язык:

1. In humid coastal areas winter temperatures are much higher than those found in the drier regions of the continental interior.
2. The process of evaporation is complex, and various factors that affect it are difficult to estimate.
3. It is obvious that the internal circulation of the ocean must be related to the oceanic structure.
4. Experience has shown that the discharge is seldom as great as that given by the equation.
5. It is the oxygen we breathe that keeps us alive.
6. If one is to make the best use of the land, the crops one grows in the different regions should be well adapted to the climates of those areas.
7. The one factor whose influence is best known and which comes nearest to accounting for the known variations of the larger kind is the one having to do with the changing surface features of the earth.

8. One should look at such empirical equation as a mathematical description of the original chart.

Упражнение 2.

Переведите предложения, обращая внимание на перевод усилительных (эмфатических) конструкций.

1. It was this project that brought this field of scientific inquiry to its present level.
2. It is physics that has given us mechanical and electrical inventions of the modern world;
3. It was only in 1840 that official records of temperature, rainfall and so on began to be kept, at the Royal Observatory, Greenwich, in London.
4. Very seldom do these thunderstorms contain hail.
5. The results of this study did show the crossover effect on frequent occasions.
6. It is by radiation that the earth receives its heat from the sun.
7. It is the weight of air that gives rise to atmospheric pressure.

Упражнение 3.

Переведите предложения, учитывая различные значения **it**.

1. It is possible to observe sunrise and sunsets on Mars just as on the Earth.
2. It seems quite certain that in the nearest future, man's action will be able to influence future climate.
3. High above the ground this wind blows so strongly that it is called the jet stream.
4. It is seen from the definition of relative humidity that it can be increased either by adding more water vapour or decreasing the «saturation specific humidity».

Упражнение 4.

Переведите, обращая внимание на различные значения **that**.

1. Chemists tell us that, out of 100 parts of atmospheric air, 99.5 consist of oxygen and nitrogen.

2. The lunar day is 24 hours and 50 minutes. That is, the moon passes a given location on earth once in that period of time.
3. The weight of the atmosphere is equal to that of a solid globe of lead sixty miles in diameter.
4. The atmosphere feeds the flame of life exactly as it does that of the fire.
5. Air density, typically of the order of 1/1000 of that of water near the ground, is almost never.

Упражнение 5.

Переведите на русский язык следующие предложения, в которых используются местоимения **that**, **one** в функции заместителей имени существительного.

1. Runoff expressed in inches was not large when compared with that in the humid eastern regions.
2. The rivers most prone to flooding are those flowing over flat, glacial lake beds.
3. The greatest flood on record is that of 1881.
4. The friction due to ice cover is very much greater that that due to air.
5. Other large and important artesian wells are those on the eastern slope of the Appalachian Mountains.
6. This lake and the one mentioned above have been badly polluted by acid rains.
7. Floats may be classed as surface and subsurface ones.

Упражнение 6.

Переведите следующие предложения, обращая на способы перевода местоимения **it**.

1. First of all it was necessary to collect as many precipitation data as possible.
2. It is clear that flood protection measures should be given due attention.
3. Water is evaporated from the earth's surface into the atmosphere where it is stored from some time.
4. It is difficult to say which one of these three flows is the most important.
5. Thus it is seen that the limitation by the plants and the soil on the evaporation often extends the true evaporating surface.

6. It seems, in the final analysis, that the evaporation from land surfaces can become as involved as an investigator wishes to make it.

Упражнение 7.

Переведите предложения, уделяя внимание усилительной конструкции.

1. It is this factor that affects surface runoff most of all.
2. It is by evaporation that moisture is returned to the air.
3. It appears that it is the flow of heat to the surface rather than the vapour flow that is the rate-limiting factor for evaporation.
4. It is only by changing the moisture entering the air over land that the total moisture received by the air can be changed, as runoff reaching the ocean does not essentially affect its evaporating area or rate of evaporation.
5. It was not until the 20-th century that the world network of hydrologic observatories was set up.

Упражнение 8.

Переведите предложения на русский язык.

1. New springs may also be created or old ones permanently altered.
2. One of the common processes in the weathering of rocks is hydration.
3. In connection with what was said above, one may make a few remarks regarding the notation of “storage coefficient”.

Упражнение 9.

Переведите, обращая внимание на различные значения **that**.

1. Meteorologists and atmospheric scientists often say that climate is what you expect; weather is what you get.
2. Although dynamical systems, like Earth's climate system, are full of complicated processes that lead to chaotic variations, changes to external forcing of the system can lead to significant changes.
3. Some gases, like carbon dioxide, have molecular structure that allows the absorption of certain wavelengths of light. In the case of "greenhouse gases," that means absorbing infrared radiation.
4. The distinguishing characteristic of a greenhouse gas is that it absorbs infrared radiation better than it does visible radiation; this allows sunlight to penetrate through the gas (the atmosphere) and warm Earth's surface.

5. The ever-increasing tendency away from regular day-night cycles of work, play and sleep means that at night, the time when our Earth should be shedding its excess heat, we are still adding to it.
6. That means that most of the energy from the cooling will still end up where it would during the day: either absorbed in the troposphere or emitted to space.
7. Also, the argument seems to imply that increased nocturnal activity by humans makes the cooling less efficient, but it is an extremely small effect.
8. Physical and computer models built to predict climate change are based on evidence gathered from glacial geologists and quaternary geologists, that infer, with varying degrees of precision, the Earth's climate history.
9. The equations of motion are the same fundamental equations that govern all classical fluid dynamics, much of energy transfer is based on well-known principles of radiative transfer and nuclear physics and spectrometry, and a lot of observations are based on geological, chemical and biological processes and methods.
10. Much of the interest in studying climate change is motivated by the idea that human activity has changed and will continue to change the climate.
11. In the absence of an atmosphere, Earth would look a lot like a black body radiator; that is to say, the sun would shine on Earth, which would warm to an equilibrium temperature, and then a balance would be struck.
12. Mostly due to the fact that Earth is so small and intercepts so little of the total energy emitted from the sun, that radiative equilibrium temperature is much lower than the sun's temperature.
13. This process, whereby energy that is emitted from the surface is absorbed by the atmosphere which then emits energy back toward the surface, is called the greenhouse effect, and it is one of the basic feedback processes in the climate system.
14. The energy flux incident at the Earth is the solar constant, but notice that the solar flux would not fall evenly on the surface of the planet.
15. The light that reaches the sun arrives over a broad range of frequencies, but the peak frequencies are in the visible portion of the electromagnetic spectrum.
16. Kepler showed that orbits are ellipses, rather than perfect circles.

Упражнение 10.

Переведите, обращая внимание на различные значения **that**.

1. That is to say, where the sun shines has a direct impact on weather and climate.
2. The principle is simply that the curvature of the Earth means that the same radiance (or photon flux or sunshine) gets spread over a larger area as the angle between the photons and the normal to the surface increases from zero to 90 degrees at the poles.
3. From everyday experience, we know that the sun appears at different distances above the horizon over the course of the day.
4. Define a new angle, that between Earth's equator and the highest local position of the sun (the position at local noon), and call this the declination angle; it is essentially a measure of the height above the horizon that the sun will reach each day, and is equal to the latitude at which the sun is directly overhead at noon.
5. This includes not-so-distant climates, like that of the "little ice age," and also the global-scale oscillations known as ice ages.
6. Note that the science of climate prediction differs fundamentally from that of weather prediction.
7. First of all, we restrict ourselves to numerical models, specifically those designed to be solved with computers.
8. More generally, any equation or set of equations that represents the climate system is a climate model. Some of these can be solved analytically, but those are highly simplified models, which are sometimes incorporated in numerical models.
9. Those sediments are deposited downstream, and over time they are compacted and form sedimentary rocks.
10. Those combining planetary science with geologic evidence have significant findings suggesting that our present inter-glacial period has not peaked.
11. While the case of Earth's climate is unlikely to be that sensitive, it does mean that we shouldn't expect a perfect long-term (greater than 2 weeks) weather forecast to be on the local television station any time soon (or ever).
12. That interaction between photons and molecules increases the temperature of the atmosphere, which then emits at a slightly different wavelength.

13. We know that the atmosphere consists primarily of the gaseous envelop around Earth, and that pressure decreases with height, according to the hydrostatic approximation.
14. The amount that is radiated to space (which differs from that emitted by the surface because of the greenhouse effect) is often called *outgoing longwave radiation* (OLR).
15. Various atmospheric constituents absorb infrared energy, then emit at a wavelength commensurate with the temperature of that part of the atmosphere.

Упражнение 11.

Переведите, обращая внимание на различные значения **that**.

1. Here we discuss several classes of models, with an emphasis on atmospheric models. The discussion closely follows that of Henderson-Sellers and McGuffie (1987), which is an excellent resource on the subject (and has an updated edition).
2. One of the most interesting aspects of these simple models is that they already produce multiple equilibria, having solutions for ice-free and ice-covered Earths as well as a more temperate solution (like the current climate).
3. Given constant boundary conditions, the model will equilibrate such that the energy budget is balanced, giving a model of the vertical (especially temperature) structure of the atmosphere.
4. Given particular conditions, it is expected that the sea ice in the North Pole region will completely melt in the summer.
5. The Earth's surface obtains energy from four primary sources: space (predominantly solar radiation), the molten core of the Earth, anthropogenic processes that generate excess heat, and radiation from the atmosphere.

Упражнение 12.

Переведите следующие предложения, обращая внимание на способы перевода местоимения **it**.

1. Climate is a broad term, but it always describes a long-term average of a system.
2. All planets with rotational days unequal to their orbital years absorb their sun's heat during their day and release it at night.

3. This is all to say that climate science is a multi-disciplinary field, with diverse (even disparate at times) interests and applications. It is unified only by the end goal: to understand the physical processes governing our natural world.
4. The emission from the atmosphere goes both out to space and downward, back to the ground where it is absorbed by the surface. It increases the surface temperature on Earth from the radiative equilibrium temperature to a much more life-friendly temperature.
5. Nearly all the energy impacting Earth's climate comes from the sun, even if it is sometimes indirectly.
6. This section should make it clear that the geometry of the Sun-Earth system plays a key role in how much sunlight reaches Earth and where it arrives.
7. First consider conservation of energy in an equilibrium system. This could be a tank of water with a heating lamp above it all enclosed in a box. It could be a simple blackbody system, or any isolated system.
8. What happens to incoming solar radiation when it arrives in the atmosphere?
9. The photon can continue unimpeded, ultimately reaching the surface and being absorbed or reflected; while the photon is traveling through a medium without interacting, it is said to be transmitted.
10. It is impossible to enumerate and describe every climate model that has ever been developed; even doing so for the published literature would be prohibitively difficult.

Упражнение 13.

Переведите следующие предложения, обращая внимание на способы перевода местоимения **it**.

1. It should also be noted that the shortwave light reflected by the surface does have a chance of being reflected (by clouds or particulate matter) or absorbed by atmospheric constituents.
2. It is the presence of the atmosphere – because of its ability to absorb the emitted infrared radiation – that the surface temperature is a much more comfortable temperature.
3. What is it that allows the atmosphere to absorb infrared radiation, and for that matter, why is it so transparent to visible radiation?

4. When the model is used to approximate the equations of motion on a sphere, it can be called a *general circulation model* (GCM).
5. Before starting to describe the uncertainty associated with climate models, it is important to emphasize that climate models are the best tools currently available for studying the climate of Earth and other planets.
6. In fact, in chaotic systems it has been shown that arbitrarily small errors in the initial conditions can give wildly different results after some amount of time.
7. It has been shown that the globally averaged surface temperature is now warmer than it has been for at least 150 years.
8. Earth is now absorbing 0.85±0.15 W m^{-2} more energy from the Sun than it is emitting to space.
9. While it is nice to think that changing our energy consumption habits will stop global warming, it could very well be that climate change is being driven by processes that we have little control over.
10. Liquid water gets deep into the ice sheet, lubricating and destabilizing it, and huge discharges of ice spill into the north Atlantic.

5. Конверсия

Конверсия – это способ образования одной части речи от другой без добавления суффиксов и приставок и без изменения основной формы слова. Например:

Глагол	Существительное
to use – использовать	use – использование
to increase – увеличивать	increase – увеличение
to produce – производить	produce – продукты, изделия
to effect – влиять	effect – влияние

Тренировочные упражнения

Упражнение 1.

Определите, к какой части речи принадлежат выделенные слова. Переведите предложения.

1. A slight rise in the grass-surface temperature can be noted at 20 hr.
2. As the temperature of the air in the bulb rises air expands and the liquid in the stem falls, whereas it rises as the temperature falls.

3. Most of the troposphere is filled with west winds which increase with height.
4. This increase is consistent with the «thermal» wind equation, since temperatures decrease poleward from the equator.
5. The pressure decreases with height.
6. The decrease with height depends primarily on temperature.
7. The temperature changes caused by radiatively active pollutants remain a minor factor in the development of vertical temperature structure.
8. As the temperature of both glass and mercury changes, their volumes change.
9. The barometer drops rapidly as the storm approaches.
10. The approach of the storm can be determined by the drops of the barometer.
11. Weather conditions affect pollutant concentrations and there are some effects of pollutants on weather.

Упражнение 2.

Определите, к какой части речи принадлежат выделенные слова. Переведите предложения.

1. Often 'climate' is used to mean the long-term mean state of the atmosphere, including temperature, humidity, and wind.
2. Anthropogenic means "human caused," form "anthro-", meaning "human," and "genic," meaning "produced by, origin, cause".
3. Global warming, or anthropogenic global warming, is the difference in the global mean temperature in a world with artificially elevated carbon dioxide compared to a reference state (which is usually taken as a time before the Industrial Revolution).
4. When the trend leads to a change larger than the natural variability, a statistically significant change most certainly has occurred.
5. More energy leads directly to higher temperature, hence climate change.
6. The absorption and subsequent emission by greenhouse gases changes the effective emission temperature of Earth (as seen from space).
7. Earth's obliquity slowly changes in time, which has important consequences for very long-term climate change.

8. Seasons are more extreme with larger obliquity, and high latitudes (e.g. Antarctica) experience more extreme changes in insolation than the tropics, leading to more pronounced season.
9. Consider the change in incoming energy in say 6800 km versus the Earth-sun distance: it is minuscule.
10. Perhaps the most profound influence on the Earth-Sun system is the geometry involved.
11. This difference does not cause Earth's seasons, but can influence the severity of seasons (discussed in the paleoclimate section) and does introduce small variations to the annual incoming solar radiation ("insolation") as there are very slow variations in the eccentricity.
12. In addition to the findings about the complex interplay between atmosphere and ocean, the current climate models from the Max Planck Institute for Meteorology also include new findings about the effects of aerosols and the influence of the earth's carbon cycle.
13. In an idealized system, where the orbit is circular and the planet's spin axis is perpendicular to the ecliptic (i.e. obliquity equal to zero), the problem becomes nearly trivial because every day is identical.
14. The amount of light absorbed by the surface is not exactly equal to the transmitted light.
15. Of course, only half the planet faces the sun at any instant in time. Half the planet faces the sun, half is in darkness.
16. The outgoing longwave radiation balances the net shortwave at the top of the atmosphere when the system is in equilibrium.
17. The photons (electromagnetic energy) emitted from the sun reach Earth's orbit in about 8 minutes.
18. Snow and ice reflect up to 80% of incident light, while open ocean surfaces reflect almost none.
19. The climate system contains important contributions and interactions among the lithosphere (the solid Earth), the biosphere (e.g., marine phytoplankton, tropical rainforests), atmospheric and oceanic chemistry (e.g., stratospheric ozone), and even molecular dynamics (e.g. radiative transfer).
20. The horizontal transport is typically given by an eddy diffusion term, which is just a coefficient multiplied by the meridional (north-south) temperature gradient.

21. For the contemporary climate, the precession only matters because it determines the relative position of the poles to the sun during Earth's orbit.
22. Extreme weather events in Europe will increase in frequency and strength.
23. Increases in precipitation over Greenland, combined with other warming effects there, leads to pools of liquid water that melt into the ice sheet as moulins.
24. The data and results will be made available, in particular, to research groups that deal with the effects of climate.
25. Different climate models, and here we want to imply sophisticated numerical models (usually of the whole globle), get different results for the same experiment.

6. Существительное в функции определения

Если подряд стоят два или более существительных без предлогов, образуя так называемую «цепочку существительных», то все они являются определениями к последнему в этой «цепочке» существительному. При переводе на русский язык существительному в функции определения может соответствовать:

– либо прилагательное (sea salt – морская соль, topmost layers – верхние слои);

– либо существительное в родительном падеже (water surface – поверхность воды, climate changes – изменения климата);

– либо существительное с предлогом (rainfall information – сведения об осадках).

Тренировочные упражнения

Упражнение 1.

Переведите следующие словосочетания на русский язык:
Boundary layer effects, low salinity water surface, regime shifts, acid rains, insect larvae, water life, sulphur dioxide, evaporation rates, precipitation data.

Упражнение 2.

Переведите словосочетания, учитывая правило «цепочки существительных».

1. Vapour pressure ..., saturation vapour pressure ...; 2. Water particles ..., water particles attraction ...; 3. Temperature drop ..., temperature drop increase ...; 4. Air mass temperature ..., air mass temperature increase ...; 5. saturation zones; 6. soil layers; 7. city park ponds; 8. stream channels; 9. surface runoff.

Упражнение 3.

Переведите следующие словосочетания на русский язык:
radiation components, summer months, heat storage term, preliminary analysis, spring melt period, melting ice, the mass of ice melted, ice cover, throughout a winter season, heat flow, the amount of radiation absorbed.

Упражнение 4.

Переведите предложения на русский язык, обращая внимание на цепочки существительных.

1. The cold season circulation pattern is clearly stronger than in the annual mean.
2. The warming of the ocean area south of 50 N was associated with a local increase in the westerly wind speed that generally corresponds to an increase in oceanic heat loss.
3. Temperature, salinity and pressure work together to determine water density.
4. When the temperature is sufficiently low, ice crystals occur, and once they are present in sufficient concentrations, the entire cloud tends to be transformed into ice crystals.
5. The equilibrium vapour pressure over ice is less than that over liquid water at temperatures below 0 C.
6. Since ice nuclei occur in much smaller numbers than condensation nuclei, this process leads to the formation of ice crystals.
7. The size of the cloud particles which form by condensation depends on the rate and duration of the vertical motion.
8. The explanation is that the process of ice formation, whether by freezing or liquid drops or the condensation of vapour directly into ice crystals, also requires nucleation.
9. A working weather modification program can alter the weather statistics and, therefore, the local ecology.

10. In the absence of surfaces, the vapour pressure can exceed the saturation value several-fold before condensation begins.
11. If the cooling of air is carried out at constant pressure, the temperature at which saturation is reached is called the dew point.
12. Recently, attempts have been made to compute the amount of effect of various treatments to augment warm cloud precipitation from schematic models of cumulus clouds, using hogh-speed digital computers.

Упражнение 5.

Переведите предложения на русский язык, обращая внимание на цепочки существительных.

1. Flash flood events arise from high to extremely high rainfall rates, whereas river flood events are associated with rainfall events over days and perhaps months.
2. The vertical moisture flux can be related to the condensation rate, which in turn is the ultimate source for precipitation.
3. This means rising air should have a substantial water vapour content and a rapid ascent rate if a significant precipitation rate is to develop.
4. Precipitation efficiency is defined as the ratio of the mass of water falling as precipitation to the influx of water vapour mass into the cloud.
5. Complete oxygen depletion kills all forms of aquatic life except anaerobic bacteria, which do not require oxygen to break down organic material.
6. Plant diversity is low in the northern forests, because few species can survive the long, cold winters, when soil moisture is frozen.
7. Other abiotic factors, such as soil type, light, and fire can act as limiting factors that cause variations in the plant life of major biomes.
8. Some aspects of groundwater pollution can be controlled by parts of existing water pollution control laws.
9. Such a strategy will require greatly increased efforts to control soil erosion through conservation and land-use control for farms, construction sites, and suburban and urban areas.
10. In urban areas most waterborne wastes from homes, businesses, factories, and storm runoff flow through a network of sewer pipes to sewage treatment plants.

11. The science in this early effort is far from the level of climate science today, but Marsh does link land use change, including deforestation and irrigation, to changes in the local climate.

7. Предложения с вводящим словом *there*

В сочетаниях *there* с глаголом *to be* в разных временных формах (*there is, there are, there was, there were, there will be, there has been* и т.д.) слово *there* самостоятельного значения не имеет, и все сочетание переводится целиком словами есть, имеется, существует, был, существовал, будет и т.п. Например:

There are many types of climates across the Earth.

На Земле есть много типов климата.

In 2005 there were 12 named storms and 4 hurricanes in the USA.

В 2005 году в США наблюдалось 12 получивших имена штормов и 4 урагана.

There will be a noticeable increase in the earth's average temperature in the next decade.

В следующем десятилетии будет наблюдаться заметное увеличение средней температуры земли.

Слово *there* сочетается не только с глаголом *to be*, но и с модальными и некоторыми другими глаголами: *should, must, can, may; exist, come, live*. При этом на русский язык переводится только глагол. Например:

There must be some available method of estimating net effective rainfall.

Для определения общего количества осадков должен существовать некий доступный метод.

There exist different kinds of precipitation.

Существуют различные виды осадков.

Если в предложении с вводящим словом there есть и наречие there, то оно ставится в конце. Например:

There were several fertilizers applied there.

Там вносилось несколько удобрений.

Тренировочные упражнения

Упражнение 1.

Переведите предложения на русский язык.

1. There remains to be mentioned only one point known as the "extended duration" period.
2. For millions of years there have been repeated advances and retreats of the sea over many districts.
3. If there is no relatively impervious stratum above the water table, there may be no surface runoff, and the flow will be well sustained.
4. From the geographical point of view there is thus a general and regional oceanography both using statistical and descriptive methods.

Упражнение 2.

Переведите, обращая внимание на порядок слов в русском предложении.

1. There are about 7000 synoptic weather stations on earth.
2. There is the formation of a pollutant layer in the city.
3. There are many physical models of tornadoes.
4. Today there is a lot of information about past climate.
5. Through geologic time there has been constant change in springs.
6. Representative are the conditions that prevail in the wet southern part of Iceland. The climate there is decidedly maritime.

Упражнение 3.

Переведите предложения на русский язык.

1. Where there is water, there is life.
2. There is not much rainfall in this region in summer.
3. There is a great variety of instruments used for measuring the amount of precipitation.
4. The topography varies from morainic to flat but there is very little swamp land.
5. The greatest flood regarding which there is reliable information occurred in 1897.
6. Thus there are three major estimates of the extent of flood damage.
7. There has been much dispute over the applicability of this method in agricultural hydrology.

Упражнение 4.

Переведите предложения на русский язык, обращая внимание на перевод оборота «There + be».

1. In the last days of July 2001 there was a big rain event.

2. In such soils there are also very big pores which are connected to each other.
3. There is one type of climate over the equatorial Pacific Ocean and another type at the North Pole.
4. Due to friction there is a progressive loss of energy by the sea waves with an increase in depth.
5. In deserts there is a great difference between day and night temperatures.
6. In colder districts there will be no need for costly containers to transport ice, it will be dumped into regular water catchments and sold in retail outlets.
7. There is a great deal of study to be done.
8. There were many reasons for ocean study.
9. There is much cooperation between the scientists.
10. There will be more understanding between oceanologists.
11. There has been much radioactive waste.
12. If there are clouds the white light will dilute the blue.
13. There are important consequences for long-term climate change.
14. There are many classes of models, and within each class there are many implementations and variations.
15. For example there are simple equivalent barotropic models of the atmosphere.

Упражнение 5.

Переведите предложения на русский язык, обращая внимание на перевод оборота «There + be».

1. There are also clear connections with the cryosphere (glaciology) and the biosphere (biology, ecology).
2. When there is an atmosphere, like the one on Earth, some of the gases that make up the atmosphere can absorb infrared radiation.
3. Using the solar constant, we can calculate Earth's temperature if there were no atmosphere.
4. However, if we allow the solar constant to be constant at the equator and the poles, there is still an important effect of geometry, namely the angle between the incoming photons (which we can think of as parallel rays of light) and the direction normal to the surface (which can be thought of as the local vertical direction, looking straight up, the sun is not always overhead).

5. We know the solar constant ($1367 Wm^{-2}$), so if we integrate over the Earth's surface, we know how much incoming energy there is.
6. There are really just three paths a photon (a "particle" of light) can take.
7. We can (to a reasonable approximation) assume that the atmosphere is transparent to shortwave radiation, meaning there will be no absorption.
8. Of course, in reality there is some emissivity associated with different surface types, but we neglect that here.
9. These time scales are greater than centuries, and there are important millennial and multi-millennial signals in the so-called paleo record.
10. At time scales even longer than ice ages (105 years), there are large variations of climate associated more with geological processes than atmospheric and oceanic.
11. There are many classes of models, and within each class there are many implementations and variations.
12. In fact, there are entire volumes devoted to the history of numerical modeling of just the atmosphere.

Упражнение 6.

Переведите предложения на русский язык, обращая внимание на перевод оборота «There + be».

1. In the ocean, there are simple box models that are somewhat analogous to the axially symmetric models of the meridional circulation of the atmosphere.
2. For example there are simple equivalent barotropic models of the atmosphere.
3. That there is some uncertainty most decidedly does not mean that we can't trust climate model results, nor does it mean there is built in "wiggle room" in the models.
4. While there were many skeptical scientists in the past, as the evidence has mounted (especially using satellite-based data), even the most ardent skeptics have come to the determination that humans are changing the climate.
5. Increases in precipitation over Greenland, combined with other warming effects there, leads to pools of liquid water that melt into the ice sheet as moulins.

6. We can imagine it is the level at which the downward shortwave radiative flux is negligibly different from the solar constant and where there is negligible downward longwave flux (that due to the sun, which is small).

8. Глаголы, выражающие долженствование

Долженствование выражается рядом модальных глаголов, за которыми непосредственно следует инфинитив (с частицей to или без нее). Особенности значения этих модальных глаголов показаны в следующей таблице:

Глагол	Значение	Перевод
Must/have to	необходимость совершить действие в силу обстоятельств	должен, вынужден
be to	необходимость совершить действие в связи с предварительной договоренностью или имеющимися планами	должен, обязан
should/ought to	совет, рекомендация	должен, следует

Например:

If we are to understand why water has the properties it does, we must take a look at the atom itself.

Если нам нужно понять, почему вода имеет свои свойства, мы должны взглянуть на сам атом.

To ensure a continuous supply of water, a well should penetrate many meters below the water table.

Для бесперебойного водоснабжения колодец должен быть на много метров ниже водного зеркала.

Сложные формы инфинитива широко используются с модальными глаголами. Пассивный инфинитив обозначает действие, которое может или должно произойти с подлежащим.

Например:

The importance of climate in the affairs of man cannot be doubted.
Никто не сомневается в важности климата для жизни человека.

Перфектный инфинитив после модальных глаголов употребляется по отношению к действиям в прошлом и придает сочетанию модального глагола и инфинитива особое значение в зависимости от модального глагола:

1. Can/could + перфектный инфинитив обозначает действие, которое могло произойти, но не произошло (упущенная возможность). Например:

We can have achieved better results. Мы могли получить лучшие результаты.

2. May/might + перфектный инфинитив обозначает действие, которое, возможно, имело место в прошлом (небольшая степень уверенности). Например:

Contraction of the ocean water may have lowered the sea level by about 10 m. Возможно, сжатие воды в океане понизило уровень моря на 10 м.

3. Must + перфектный инфинитив обозначает действие, которое, должно быть, имело место в прошлом (большая степень уверенности). Например:

This submergence must have been caused by a subsidence of the continent, a rise in the sea level, or a combination of the two.Это затопление, должно быть, было вызвано погружением континентов, подъемом уровня моря, или сочетанием этих двух факторов.

4. Should/ought to + перфектный инфинитив содержит упрек относительно действия, произведенного в прошлом. Например:

The government should have adopted clear agricultural policy long ago.Правительству следовало бы принять четкую аграрную политику еще несколько лет тому назад.

Тренировочные упражнения

Упражнение 1.

Укажите предложения, в которых глагол *to be* выражает долженствование.

1. Many moisture variables are in meteorological use.
2. The lunar day is 24 hours and 50 minutes in duration.
2. The earth is rotating at great speed (1600 km/hr) relative to the moon.

3. The meteorological stations are spaced uniformly.
4. The next step was to introduce an allowance for the difference in temperature at different levels.

Упражнение 2.

Переведите предложения, обращая внимание па модальные глаголы.

1. Energy may reach 30 m/s (65 mph) and more in gusts in Africa.
2. The wind shear must be strong to overcome the effect of the stratification.
3. Parts of the tropical zone can be very suitable for human occupation.
4. A charge separation must take place inside the thunderstorm cloud.
5. Cloud thickness may be 3 km or more, probably giving some showers.

Упражнение 3.

Переведите предложения, содержащие сказуемые с модальными глаголами.

1. An air mass may be heated from below.
2. Similarly, but in reverse, it can be cooled from below.
3. Changes must also occur through increased evaporation.
4. Heating from below may be spread rapidly.
5. The abstraction of moisture by condensation or precipitation can also cause changes.
6. Large-scale lifting may result from forced ascent by a mountain barrier.
7. Horizontal inflow or outflow near the surface has to be compensated.
8. Evapotranspiration losses from natural surfaces cannot be measured directly.
9. The speed has to be corrected because the instrument is not at the standard height.

Упражнение 4.

Переведите предложения, обращая внимание на модальные глаголы и их эквиваленты.

1. Certain features of global climate can be studied by physical models.
2. A lot of meteorological stations should be set up in the inner city.
3. Both dew-point and wet-bulb temperatures can be easily measured.
4. Generally, compromise solutions have to be found.

5. Every household should possess several thermometers such as a room thermometer, an out-of-door thermometer, and a clinic or «fever» thermometer.

Упражнение 5.

Переведите на русский язык следующие предложения.

1. Some of the precipitated water may penetrate into deeper layers. A return to cold weather may arrest the snowmelt runoff.
2. An extraordinary storm can occur, and yet produce little runoff. In summer these rates can be as low as 0.1 inch per hour.
3. Acid rains may have been the cause of the death of fish at least in some of the lakes.
4. The annual flow data will also have to be taken into consideration.
5. Bridge crossings must be wide and high enough to clear the specified flood without causing backwater.
6. In extremely swift water it may be impracticable to sink the meter far below the surface.
7. Flood-forecasting services should be recognized as an essential part of flood management.
8. These insignificant water losses need not be taken into account.
9. The snowmelt measurements should have been made under different conditions.
10. If we are to find an acceptable solution to this problem, we shall have to carry out a great many more field studies.
11. The stream velocity values ought to be checked thoroughly.
12. Some of the water may have penetrated into deeper layers.

Упражнение 6.

Поставьте глаголы-сказуемые в следующих предложениях в прошедшее и будущее время.

1. We can use another technique for analyzing the data obtained.
2. The problem must be solved as soon as possible
3. Researchers must find a reliable means of protecting populated areas from landslides.

Упражнение 7.

Переведите на русский язык следующие предложения.

1. For better accuracy annual rainfall should be measured at as many points as possible.
2. Fertilizers are to be used very carefully to avoid polluting adjacent streams.
3. River discharge data will also have to be analyzed thoroughly.
4. Allowance should be made for the silting of the reservoir.
5. Nearly all usable water in deserts is to be found almost exclusively underground.

Упражнение 8.

Переведите предложения, обращая внимание на модальные глаголы и их глаголы-заменители.

1. As a thought experiment, consider all the absorption by greenhouse gases happening in a thin layer of the atmosphere, which can effectively be thought of as a thin shell around the Earth.
2. Modeling studies might compare simulations with different levels of carbon dioxide, or an observational study might describe a slowly changing quantity, like sea-ice concentration, over a long period of time.
3. For this exercise, two lengths are crucial, but can be measured quite well: the distance between the Earth and sun and the sun's radius.
4. Combining these distances with the solar constant (ΦE = 1367 Wm^{-2}) can provide us with an estimate of the sun's effective surface temperature.
5. All this energy has to pass through the sphere defined by the radius of the sun as well, which means a shell with surface area $4\pi r^2$ where r is the sun's radius.
6. In the case of Earth (as the "system"), this means that the energy coming in (the sunlight) must be balanced by outgoing radiation.
7. This incoming energy, sometimes called solar insolation or downward shortwave radiation, needs to be balanced. If it is not balanced by an equal loss of energy, then the temperature of the system must change (this is the 1st law of thermodynamics).
8. The photon can be reflected, which means that the path of the photon is reversed.
9. These are generic models, which can be specialized to simulate the ocean, atmosphere, or other fluid problems.

10. Radiative-convective models can be used to represent the global average atmosphere, a particular latitude (zone), or a particular location. The resolved dimension is vertical, so all the horizontal fluxes (like winds and advected scalars like temperature and moisture) must be passed to the column somehow.
11. The global temperature could rise by up to four degrees by the end of the century.
12. Almost everywhere on earth, the forestry industry will have to husband different types of trees than it has until now.
13. As scientists, we want to provide politicians with a decision paper that is as understandable as possible, and from which they can decide which measures ought to be politically implemented as urgently as possible.

9. Причастие I

Причастие I – причастие настоящего времени действительного залога – образуется от инфинитива глагола прибавлением к нему суффикса *-ing*. Например: read + -ing = reading.

Причастие I на русский язык переводится причастием с окончанием *-щий* или деепричастием. Например:

reading – читающий, читая.

В предложении причастие I служит:

1) определением и употребляется либо перед определяемым словом (т.е. слева), либо после определяемого слова (т.е. справа). В последнем случае оно, вместе с уточняющими его словами, образует причастный оборот. Например:

Everybody listened to the reading student.

Все слушали читающего студента.

Everybody listened to the student reading the newspaper.

Все слушали студента, читающего газету.

2) обстоятельством и употребляется в начале или в конце предложения. Вместе с уточняющими его словами соответствует русскому деепричастному обороту. Например:

Reading the new text the student made no mistakes.

Читая новый текст, студент не сделал ошибок.

3) частью сказуемого. Вместе с глаголом *to be* образует формы времен группы Continuous. Например:

The student is reading a newspaper now. Студент сейчас читает газету.

Тренировочные упражнения

Упражнение 1.

Переведите следующие предложения на русский язык.

1. These trends can vary greatly depending on the period over which they are calculated.
2. When the beer bottle recycling system was set up, a number of businesses and unions representing aluminum workers protested rather vigorously.
3. Globally, October 2005 was the warmest October on record, surpassing that of last year and June 2005 was the warmest June, surpassing that of 1998.
4. This is why winds blowing northwards parallel to the coastline of Peru "drag" surface water westwards away from the shore.

10. Причастие II

Причастие II – причастие прошедшего времени страдательного залога – у правильных глаголов образуется от инфинитива при помощи суффикса *-ed*, а у неправильных глаголов является третьей формой. Если глагол оканчивается на букву *e*, то перед суффиксом *-ed* она опускается. Например:

produce + ed -> produced, write -> written.

Причастие II переводится на русский язык причастиями с окончаниями *-ный, -мый, -тый*. Например:

produced – производимый, произведенный, written – написанный.

В предложении причастие II служит:

1) определением, и тогда оно стоит либо перед определяемым существительным, либо после него, образуя вместе с уточняющими его словами причастный оборот. Например:

The results obtained were very useful.

Полученные результаты были очень полезны.

2) частью сказуемого в страдательном залоге (Passive Voice). Например:

Some insolation is reflected into space by the air.

Часть солнечной радиации отражается атмосферой в космос.

3) частью сказуемого времен группы Perfect. Например:

Scientists have not developed a completely satisfactory explanation for the causes of the ice age yet.

Ученые еще не дали достаточно удовлетворительного объяснения относительно причин ледникового периода.

Тренировочные упражнения

Упражнение 1. Переведите предложения на русский язык.

1. The mixed layer is near the surface where the temperature is roughly that of surface water.
2. Rainfall, considered apart from temperature, gives no clue to climate.
3. In northern areas thousands of abandoned mines are leaking dissolved metals into ground and surface waters.
4. Late in the ninth century aided by a period of climatic warming the Vikings conquered Iceland.

11. Причастие II в функции правого определения к существительному (в постпозиции)

Причастие II, не имеющее уточняющих слов, также может стоять справа от существительного. В этом случае в русском переводе оно стоит перед существительным. Например:

When the air is hot and not dusty, the amount absorbed is not great.

Когда воздух горячий и не пыльный, поглощенное количество невелико.

Причастие II в этой функции следует отличать от причастия II в причастном обороте, которое тоже стоит справа от существительного, но имеет зависимые слова.

12. Причастия простые и сложные

Причастия бывают простые, т.е. состоящие из одного слова, и сложные, состоящие из двух-трех слов (см. следующую таблицу).

	Active	Passive
Present Participle I	producing производящий, производя	being produced будучи производимым когда / так как производили
Past Participle II	–	produced производимый, произведенный
Perfect	having produced произведя	having been produced после того как / когда произвели

Например:

Air passing over water areas is cooled in summer and warmed in winter.

Воздух, проходя над водной поверхностью, охлаждается летом и нагревается зимой.

Having grown up in an industrial town in the 1930s and 40s, Mackay vowed to study the impacts of industrial processes on a community.

Так как Макей вырос в промышленном городке в 30–40-е годы, он дал себе клятву изучить влияние промышленных процессов на население.

The problem being mentioned should be solved.

Упоминаемая проблема должна быть решена.

Far more people live on plains than on the plateaus and mountains combined.

На равнинах живет гораздо больше людей, чем на возвышенностях и в горах, вместе взятых.

Having been examined individually, the most important components of climate need further investigation.

После того, как важнейшие компоненты климата были изучены по отдельности, их исследование следует продолжить.

Сложные причастия выполняют в предложении, как правило, функцию обстоятельства и обозначают дополнительные действия, которые совершаются с подлежащим или которые подлежащее само совершает наряду с действиями, обозначенными сказуемым.

Причастие I страдательного залога (Participle I Passive) обозначает действие, которое совершают с подлежащим в то же самое время, когда происходит действие, обозначенное сказуемым.

Переводить на русский язык причастный оборот, образуемый сложными причастиями страдательного залога, лучше придаточным предложением, первоначально уяснив для себя связь между действиями. Придаточное предложение, как правило, начинается словами когда, так как или после того как (см. таблицу).

Перфектное причастие действительного залога (Perfect Active Participle) обозначает действие, которое подлежащее выполнило раньше, чем действие, выраженное сказуемым.

Причастные обороты, образуемые перфектным причастием действительного залога, переводятся на русский язык деепричастными оборотами с деепричастием совершенного вида.

Перфектное причастие страдательного залога (Perfect Passive Participle) обозначает действие, которое совершили с подлежащим раньше, чем другое действие, выраженное сказуемым.

Тренировочные упражнения

Упражнение 1.

Переведите следующие предложения на русский язык:

1. Quarts is one of the commonest minerals being present in many rocks and soils in a wide variety of forms.
2. Having learned the characteristics of the important rocks we can more easily see how various external and internal earth forces acting on them have produced our present topography.
3. Being cut by rapids the rivers of the USA serve as immense source of electric power.
4. The tools and methods employed in underwater surveying vary with the areas being surveyed and the requirements placed on the oceanographers performing the work.
5. Most of the soils of the Columbia Plateau are very fertile having been formed originally from lava.

Упражнение 2.

Переведите предложения, учитывая функцию причастий (определение, обстоятельство, часть сказуемого).

1. Convergence occurs when there is a net accumulation of air in a limited sector.

2. Vertical motion is extremely slow compared with convective and downdraught currents.
3. The air within a depression can be regarded as comprising an infinite number of small air parcels.
4. These are the horizontal flow patterns producing divergence and convergence.

Упражнение 3.

Переведите предложения, учитывая функцию причастий (определение, обстоятельство, часть сказуемого).

1. Convergence occurs when there is a net accumulation of air in a net accumulation of air in a limited sector.
2. Vertical motion is extremely slow compared with convective and downdraught currents.
3. The air within a depression can he regarded as comprising an infinite number of small air parcels.
4. These are the horizontal flow patterns producing divergence and convergence.
5. Anticyclonic vorticity occurs with the corresponding anticyclonic situation,
6. The tropical sources are maritime, originating in the oceanic subtropical high-pressure cells.
7. The maritime type is characterized by high temperatures accentuated by the warming action to which the descending air is subjected.

Упражнение 4.

Преобразуйте сложные предложения с придаточным обстоятельственным в простое предложение с причастным оборотом.

Образец: When ice crystals are formed, they grow rapidly. – When formed ice crystals grow rapidly.

1. When evaporation from oceans, lakes and moisture transpired from plants are taken together, they are often referred to as evapotranspiration.
2. When the water is converted into ice, its composition is not changed.
3. When these patterns are seen on satellite photographs, they are cellular, with a typical diameter of 30 km.

Упражнение 5.

Определите функцию подчеркнутого причастия (определение, обстоятельство, часть сказуемого), предложения переведите.

1. A volume increase involves work and the consumption of energy, thus reducing the heat.
2. Prolonged reduction of the temperature produces condensation.
3. Latent heat is liberated, counteracting the dry adiabatic temperature decrease.
4. The maritime type is characterized by high temperatures accentuated by the warming action to which the descending air is subjected.
5. There is a temperature inversion – a layer of the atmosphere in which the temperature is increasing with the layer to have the same condensation level.
6. The cloud has an arched top find a flat base.
7. When falling, rain is evaporated into tire air.
8. Stratus is the name given lo layers of clouds which show no internal structure.

Упражнение 6.

Переведите предложения на русский язык, обращая внимание на *ing*-формы.

1. Climatology is a young science, with modern climate science only emerging from meteorology, oceanography, and geology in the late 20th Century.
2. In the case of planet Earth, however, not only are we adding to the sun's heat in the daytime.
3. The gases are heated by the absorbed radiation, and then radiate isotropically (equally up and down), sending energy back toward the surface to act as an extra energy source.
4. Using Wien's law, we can calculate that temperature and establish that Earth is an infrared emitter.
5. At dawn, the sun comes over the eastern horizon, traveling in an arc across the sky, reaching its maximum height at local noon, and then descending toward the western horizon.
6. At the south pole, the sun is just at the northward horizon at local noon, providing essentially no insolation.
7. Absorbtion means that the energy associated with the photon is imparted to some atom or molecule, resulting in a higher energy level in that particle.

8. The radiative flux from the surface acts approximately according to the Steffan-Boltzmann and Wien's laws of blackbody radiation.
9. From space, the emission from the planet will be coming from an elevated level, with a much colder temperature than the surface.
10. In fluid dynamics, some systems are now modeled using "direct numerical simulation" (DNS), in which nearly all the active scales are explicitly resolved.
11. The results confirm speculations over recent years that humans are having a large and unprecedented influence on the climate and are fuelling global warming.
12. Huge discharges of ice spill into the north Atlantic, chilling and freshening the surface water, stabilizing the upper ocean.

Упражнение 7.

Переведите предложения. Определите, есть ли в предложении Past Participle.

1. The study of climate – sometimes called climatology or climate science – is actually a relatively young field, but has roots in all the major branches of science.
2. Physical and computer models built to predict climate change are based on evidence gathered from glacial geologists and quaternary geologists, that infer, with varying degrees of precision, the Earth's climate history.
3. The equations of motion are the same fundamental equations that govern all classical fluid dynamics, much of energy transfer is based on well-known principles of radiative transfer and nuclear physics and spectrometry, and a lot of observations are based on geological, chemical and biological processes and methods.
4. When focused on issues of climate change, the same physical principles are at work.
5. We investigate the processes involved with climate and climate change, from the sun's influence, to the natural greenhouse effect, to observed changes in the composition of the atmosphere.
6. By the time the energy reaches Earth's orbit, the energy flux (energy per time per area) is only about 1367 W/m², the so-called solar constant.
7. Luckily, the presence of the atmosphere allows the Earth system to store somewhat more energy; the observed global average tempera-

ture is approximately 287 K (14ºC), allowing a more comfortable existence for humans.
8. Precession is the slow variation of direction of the spin axis, and is affected by both a turning of the spin axis and a slow change in the shape of Earth's orbit.
9. The insolation is reduced by the cosine of this angle, which is known as Lambert's cosine law.
10. The distribution of incoming solar radiation with current orbital parameters, averaged over each day.
11. The net shortwave, which when averaged over suitable time and over the global, is the source of energy to the climate system, but not all the solar insolation is absorbed by the earth.
12. The reflectivity of the surface is usually called the albedo, denoted α, and is simply the fraction of incident light that gets reflected.
13. Climate models come in many forms, from very simple energy-balance models to fully coupled, three dimensional atmosphere-ocean-land numerical models.
14. Simpler models have been developed over the years for many reasons.
15. These models are solved for the equilibrium temperature at each latitude based on the incoming and outgoing radiative fluxes and the horizontal transport of energy.
16. Scientists at the Max Planck Institute for Meteorology presented on Thursday, September 29, their first model calculations for the future of the climate.

Упражнение 8.

Переведите предложения на русский язык.

1. From their inception, urban parks were not conceived of as having ecological value or as being ecological restorations in the sense that we use these terms today.
2. It was constructed at great effort and expense, involving the relocation of several communities, the movement of six million cubic yards of dirt and rock, and the planting of thousands of trees.
3. For example, it is a known fact that pollution in the Arctic is caused by the consumption patterns of people living farther to the south.
4. Groundwater modelling is the only way to integrate the vast amounts of data involved and to provide the fundamental understanding of complex groundwater flow systems needed for effective management.

5. Models can give reliable water balances showing the capacity of the resource, and they can reveal flow paths showing where the water comes from, where it is going, and what migration paths contaminants will follow.
6. Having been a pioneer in groundwater research for over 30 years, Emil Frind used the occasion of his address at Environment Canada to make some observations about the state of groundwater management in Canada.
7. Regions of significant warmth were widespread with large areas of Africa, Australia, Brazil, China and the United States showing significantly above-average temperatures.
8. The information given will be useful for the farming, fishery, transport and tourism sectors.
9. A programme focusing on traditional concepts and methods will be one of the main features.
10. One oceanic process altered during an El Nino year is upwelling, which is the rising of deeper colder water to shallower depths.
11. Iceland will benefit from use of the comprehensive satellite data and images made regularly available by Meteosat-8.
12. Some of the other forecasting methods, such as numerical weather prediction, lose all their skill for forecasts longer than 10 days.
13. This sinking motion leads to generally fair skies and no precipitation near the high.
14. Having become a Category 5 storm, the central pressure fell to 922 mb and wind gusts were estimated in excess of 175 m.p.h.
15. August 26, Andrew made landfall again, this time in south central Louisiana, with a central pressure of 956 mb and sustained winds approaching 120 m.p.h.
16. Mitigation includes any activities that prevent an emergency, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies.
17. Problem issues include, for example, leaking decommissioned landfills, leaking fuel storage facilities, industrial solvents, municipal wastewater effluents, and road salt application to streets and highways.

Упражнение 9.

Переведите на русский язык следующие предложения.

1. The first physical evidence of flood is usually in the form of water running over the surface of the ground, collecting in tiny rills, and eventually flowing into the stream channels.
2. The analyses described yield a theoretical maximum flood.
3. Knowing the actual vapor pressure, the temperature of the dew point can be readily determined.
4. Flood runoff produced by these storms seldom exceeds 8 to 10 inches.
5. The chemicals most commonly used are sodium chloride (common salt) and calcium chloride.

Упражнение 10.

Переведите на русский язык следующие предложения.

1. He couldn't imagine that the earth would one day have a population over 6 billion while, at the same time, some food producing markets would experience large agricultural surpluses.
2. Road salts have been used at an increasing rate for the last 50 years, and as a result, one of the Region's well fields has been showing steadily increasing chloride concentrations.
3. The carrying capacity of the resource should be a primary factor when deciding where and how much growth should occur. Consequently, the river must assimilate an increasing load of nutrients and suspended sediment, with the result that water quality in its southern reaches is impacted.
4. It's not surprising that in the last two years, there have been substantial reductions in the global harvest because of heat- and drought-induced reductions.
5. The new rules introduced during the past thirty years include: the widespread implementation of prior environmental assessment requirements; the introduction of "zero discharge" standards or standards that drastically reduce certain toxic substances; increased penalties and sanctions for companies that commit environmental infractions; and rules which recognize the right of citizens to live in a healthy environment and to have access to environmental information.
6. This pollution prevention obligation has been taken up in numerous international declarations emanating from so-called "soft law" and in many binding international conventions established in the past thirty years.

Упражнение 11.

Переведите на русский язык следующие предложения.

1. North America is a low platform rising above the sea.
2. Repeated expansion and contraction tend to develop cracks in rocks.
3. Volcanism includes all phenomena connected with the movement of heated rock material and gases to the surface of the lithosphere.
4. Sea water contains every natural element known.
5. Formed as a result of geologic faulting, the basin of the Baltic Sea was filled with ice during the glacial period.
6. Being attached to the continent by a very narrow isthmus the Crimea Peninsula is almost entirely bounded by the sea.
7. Having learned the characteristics of the important rocks we can more easily see how various external and internal earth forces acting on them have produced our present topography.
8. Covered with steppe grasses the summits of the Crimean mountains serve as excellent summer pastures.
9. Being cut by rapids the rivers of the USA serve as immense source of electric power.
10. Being open to navigation throughout the year, the Black Sea offers an excellent route to the lands of the Mediterranean.
11. Most of the soils of the Columbia Plateau are very fertile having been formed originally from lava.
12. A river can carry a considerable load depending on the volume and the velocity of the water and on the size and nature of the solid material transported.
13. The tools and methods employed in underwater surveying vary with the areas being surveyed and the requirements placed on the oceanographers performing the work.
14. The relative importance of air transport is great in areas currently being developed.

Упражнение 12.

Переведите на русский язык следующие предложения.

1. When working in the mine we secured many interesting specimens.
2. When freezing water expands by about one tenth its volume.
3. The synoptic chart shows conditions as observed at the ground.
4. Peat when compacted by the pressure of layers of sand and clay deposited above slowly changes into "brown coal".

5. Like all substances rock expands when heated and contracts when cooled.
6. Where cleared, the deciduous forest tends to be replaced by the rich green grassy meadows.
7. Limestone when mixed with clay may provide good soils.
8. When thawed frozen soil may lose its strength.
9. Most geologic processes are very slow and geologic time is exceedingly long especially when measured by the scale of human history.
10. Ice as deposited by nature is very pure.
11. On the west, Morocco, affected by the Atlantic and the prevailing westerly winds has a humid climate which towards the east is becoming drier.
12. The North and South poles have six months of continuous daylight followed by six months of darkness each year.
13. The directions followed by the railways are determined very largely by the mountain chains.
14. The areas influenced by marine climate receive ample precipitation in all months with the maximum in the autumn and winter.

Упражнение 13.

Переведите на русский язык следующие предложения.

1. Physical oceanography is one of five sub-domains into which oceanography is divided; the other fields being biological, chemical, geological and meteorologic oceanography.
2. Variations of salinity and temperature with depth change the density of the seawater, creating the pycnocline.
3. The amount of sunlight absorbed at the surface varies strongly with latitude, being greater at the equator than at the poles, and this engenders fluid motion in both the atmosphere and ocean that acts to redistribute heat from the equator towards the poles, thereby reducing the temperature gradients that would exist in the absence of fluid motion.
4. The oceans large heat capacity moderates the climate of areas adjacent to the oceans, leading to a maritime climate at such locations.
5. The western side of the equatorial Pacific is characterized by warm, wet low pressure weather as the collected moisture is dumped in the form of typhoons and thunderstorms

6. An idealised ocean basin, spun up from rest by a cyclonic wind stress, acquires a gyre circulation with slow steady flows everywhere except in the region of the western boundary, where a thin fast polewards flow called a western boundary current develops.
7. The Kuroshio Current is an ocean current found in the western Pacific Ocean off the east coast of Taiwan and flowing northeastward past Japan, where it merges with the easterly drift of the North Pacific Current.
8. It is analogous to the Gulf Stream in the Atlantic Ocean, transporting warm, tropical water northward towards the polar region.
9. Oceanic crust is the thin layer of solidified volcanic basalt that covers the Earth's mantle where there are no continents.
10. The Mediterranean Sea is very nearly its own "ocean", being connected to the World Ocean through the Strait of Gibraltar, and indeed several times over the last few million years movement of the African Continent has closed the strait off entirely, making the Mediterranean a fourth "ocean".
11. The Antarctic Circumpolar Current encircles that continent, influencing the area's climate and connecting currents in several oceans.
12. A mediterranean sea, in oceanography, is a mostly enclosed sea that has limited exchange of deep water with outer oceans and where the water circulation is dominated by salinity and temperature differences rather than winds.
13. Unlike mediterranean seas, marginal seas have ocean currents caused by ocean winds.
14. In a state of rest or absence of external forces, the mean sea level would coincide with this geoid surface, being an equipotential surface of the Earth's gravity field. In reality, due to currents, air pressure variations, temperature and salinity variations, etc., this does not occur, not even as a long term average.
15. Waves can be described using a number of standard variables including: frequency, wavelength, amplitude and period.

13. Независимый причастный оборот

Независимый причастный оборот – это причастный оборот, имеющий свое «подлежащее».

Независимый причастный оборот распознается в предложении по следующим признакам:

1) причастие стоит на месте сказуемого и имеет свое «подлежащее»;

2) от основной части предложения оборот отделяется запятой. Предложения с независимым причастным оборотом строятся следующим образом (П – подлежащее):

П + причастие + второстепенные члены, П + сказуемое + ... или наоборот:

П + сказуемое + ..., П + причастие + второстепенные члены

Если независимый причастный оборот предшествует основной части предложения, на русский язык он переводится придаточным предложением с союзами так как, когда, если в зависимости от смысла всего предложения.

Если причастный оборот употребляется после основной части предложения, он переводится предложением, присоединяемым словами *причем, при этом, а, и*. Причастный оборот после основной части предложения может начинаться словом with, что не меняет его значения и способа перевода.

Причастие в независимом причастном обороте переводится как сказуемое. Например:

Some social indicators (e.g. education, life expectancy, health) point to improved human well-being, the long-term prospect that these changes will stabilize or improve environmental and social trends remaining uncertain.

Ряд социальных факторов (образование, продолжительность жизни, здоровье) указывает на улучшение качества жизни, при этом долговременная перспектива того, что эти изменения стабилизируются или улучшат экологические и социальные аспекты, остается неопределенной.

Тренировочные упражнения

Упражнение 1.

Переведите следующие предложения на русский язык:

1. Polar front being presented as a fact, not as a hypothesis, its existence is not discussed.
2. Runoff includes the variety of ways by which water moves across the land, the water infiltrating into the ground, evaporating into the

air, stored in lakes and reservoirsor extracted for agricultural or other human uses.
3. These reports are particularly influencial in international talks over climate treaties, especially the Kyoto Protocol, its binding limits on emissions expiring in 2012.
4. The survival attitudes caused by desertification having often led to a decline in agricultural know-how, they have conversely encouraged the development of technical "know-how" particularly relating to the environment and conservation.

Упражнение 2.

Преобразуйте сложноподчиненные предложения, используя независимый причастный оборот по образцу. Предложения переведите.

Образец: When the temperature of the air is reduced, condensation takes place. – The temperature of the air reducing, condensation takes place.

1. When the temperature of the air decreases, the air is cooled to the dew point.
2. As differences no longer exist between air masses, decay occurs.
3. Since the air temperature at the surface is about 1,5° C, mixed snow and rain is possible.
4. If there is a net accumulation of air in a limited sector, convergence takes place.
5. When several cloud layers are present in the atmosphere, natural seeding may he important.

Упражнение 3.

Соедините два предложения в одно, используя независимый причастный оборот по образцу. Предложения переведите.

Образец: Three different lapse-rates can be differentiated. Two are dynamic and one static. – Three different lapse-rates can be differentiated, two being dynamic and one static.

1. The air can be regarded as an infinite number of small air parcels. Each rotates cyclonically about an axis.
2. Only six per cent of the annual precipitation of Arizona is of local origin. The remainder is transported into this area.
3. The pressure gradient force has vertical and horizontal components. The former is more or less in balance with the force of gravity.

4. Occlusions are classified as cold or warm. The difference depends on the relative stales of air masses.

Упражнение 4.

Переведите предложения, содержащие независимый причастный оборот, учитывая его место в предложении.

1. The air being warm and moist at the surface, stratiform cloud commonly develops.
2. In summer warming of the lower layers generates a steep lapse rate, the low relative and specific humidity preventing the cloud development and precipitation.
3. The air moving downslopes into an open valley a «mountain wind» develops simultaneously along the axis of the valley.
4. There being warm afternoons, the laterallv constricted but vertically expanding air tends to blow tip the valley axis.
5. The wave form remains more or less stationary relative to the barrier, the air moving quite rapidly through it.
6. The air being colder than the air following it, the occlusion is warm.
7. The river being too deep in this place, we could not cross it.

14. Отглагольное существительное и герундий

В английском языке есть три формы с суффиксом *-ing*: причастие I, отглагольное существительное и герундий. Эти формы важно различать, чтобы суметь найти их эквиваленты в русском языке.

Русский эквивалент причастия I зависит от того, какую функцию выполняет эта форма в предложении.

При переводе на русский язык отглагольного существительного трудностей не возникает, так как в русском языке ему всегда соответствует тоже существительное. Как и обычное существительное, оно может употребляться с артиклем, иметь определение, выраженное прилагательным, иметь форму множественного числа. Чаще всего встречается следующая форма отглагольного существительного – *the planning of*, т.е. слева стоит определенный артикль, справа предлог *of*. Например:

The planning of the research is one of the essential tasks.

Планирование исследовательской работы – это одна из основных задач.

Герундий обозначает название процесса. В отличие от отглагольного существительного, за герундием часто следует прямое дополнение, т.е. дополнение без предлога, но переводятся и герундий, и отглагольное существительное одинаково. Например:
Condensation is the cooling of water vapour until it becomes a liquid.
Condensation is cooling water vapour until it becomes a liquid.
Конденсация – это охлаждение водяного пара до жидкого состояния.

Важно уметь отличить герундий от причастия I, так как их значения различны. В русском языке формы, аналогичной герундию, нет, поэтому герундий можно переводить по-разному, в зависимости от контекста: существительным, неопределенной формой глагола, деепричастием и глаголом в личной форме, если перед ним имеется притяжательное местоимение или существительное в притяжательном падеже (-'s). Например:

In areas where more than 10% of the annual precipitation falls as snow, special methods of measuring snow precipitation and storage are desirable.

В регионах, где более 10% годовых осадков выпадает в виде снега, необходимо использовать специальные методы для измерения / чтобы измерить количество выпавшего снега.

Тренировочные упражнения

Упражнение 1.

Переведите на русский язык следующие предложения:

1. After entering the soil the water particle moves downwards.
2. Before considering the development of the earth's oceans and the origin of life in those oceans, we should attempt to gain an understanding of what is known of the relationship of the earth to the cosmos.
3. Human activity, however, has upset the natural way flooding occurs by walling off rivers and straightening their courses.
4. By increasing the acidity of surface waters acid rain can kill fish and other fresh water life.
5. Since the water cycle is truly a "cycle" there is no beginning or end.

Упражнение 2.

Переведите предложения, учитывая различные функции герундия.

1. Theoretical methods for determining evaporation rates have followed two lines of approach.
2. Fog or low stratus with drizzle result from air mass mixing or warm advection.
3. This method is generally satisfactory for routine forecasting.
4. Vertical mixing has the effect of averaging these conditions through the layer affected.
5. Show occurs when the aggregations of ice crystals do not have time to melt before reaching the ground.

Упражнение 3.

Преобразуйте сложноподчиненные предложения в простое с герундиальным оборотом. Предложения переведите.

Образец: When we convert water into ice we do not change its composition. – On (in) converting water into ice we do not change its composition.

1. When minute ice crystals have formed they grow rapidly by deposition from vapour.
2. When we subject air to very great pressure and cooling it is possible to transform it to the liquid state.
3. When sea salts burst the air bubbles they enter the atmosphere.

Упражнение 4.

Переведите следующие предложения, учитывая, что суффикс *-ing* служит для образования как герундия, так и существительного.

1. Hailstones may fall considerable distances without melting.
2. The key to the understanding of condensation lies in the fine balance between these variables.
3. The depression usually achieves its maximum intensity 12–24 hours after the beginning of occlusion.
4. Anabatic winds result from greater heating of the valley sides compared with the valley floor.
5. The sky may clear very abruptly even before the passing of the surface cold front.
6. A drop of 1 mm radius falls 42 km before evaporating.

7. Typical wind speeds may be increased where low-level temperature inversion produces a «Venturi effect» in constricting and accelerating the floor.
8. The freezing of supercooled water drops may also produce ice splinters.

Упражнение 5.

Образуйте герундии, выбрав соответственно глагол:

to vaporize to burst to overcome to understand to define to express to heat to move.

Предложения переведите.

1. Sea salts enter the atmosphere by (разрывая) the air bubbles.
2. Energy is required in (для преодоления) intermodular attraction.
3. The rate of (испарения) depends on a number of factors.
4. This is of importance in (понимания) the behaviour of upper winds.
5. These forces prevent air from (прохождение) directly across the isobars.
6. (Нагревание) from below acts to increase air-mass instability.
7. Penman succeeded in (выразить) evaporation losses in terms of four meteorological elements.
8. For this purpose he suggested (определить) a convective condensation level.

Упражнение 6.

Переведите следующие предложения, учитывая различные употребления *-ing* форм.

1. This energy is generally provided by the removal of heat from the immediate surroundings causing an apparent heat loss.
2. The mixing of the differing layers within a single air mass can also produce condensation.
3. The maximum velocity occurs just before sunrise at the time of the maximum diurnal cooling.
4. The displacement of an air parcel causes an increase in its volume and a consequent lowering of its temperature.
5. Such a temperature change, involving no subtraction or addition of heat, is termed adiabatic.

Упражнение 7.

Сравните перевод глагольных форм Gerund Indefinite Active, Gerund Indefinite Passive.

It's worth noting... – it's worth being noted...; it's provided on removing ... – it's provided on being removed ...; they enter by bursting... – they enter by being burst ...; it prevents from heating... – it prevents from being heated ... ; he objected reading ... – he objected to being read ...

Упражнение 8.

Переведите предложения, учитывая различные употребления *-ing* форм.

1. It is worth noting that in the middle latitudes the Coriolis deflection causes turning of a well developed onshore sea breeze.
2. The advancing cool sea air may form a front.
3. The vertical expansion of the air column occurring daily during the hours of heating, tilts the isobaric surfaces.
4. At night the air over the sea is warmer because of the downslope winds blowing off the land.
5. A broad grouping can be made according to the mechanism of vertical motion.
6. The stability produced by the effect of surface cooling prevents vertical mixing so that further cooling occurs more slowly.
7. If an air parcel is impelled downwards it will become colder than its surroundings.
8. A well-marked low-level temperature inversion produces a «Venturi effect» in constricting and accelerating the flow.
9. Programs aimed at increasing winter snowfall by seeding cyclonic storms regard the rain- (or snow-) making as routine operations.
10. Eventually the mixing and modification necessarily accompanying the air mass movement will cause the rate of energy exchange with surrounding to diminish.
11. This convection is due to the cooling of the fog top by radiation into space.

Упражнение 9.

Переведите предложения, обращая внимание на перевод герундия.

1. In recent times, this has been taken as implying mainly the emission of "greenhouse gases" into the atmosphere, usually by burning fossil fuels.
2. If humans change the composition of the atmosphere, say by burning fossil fuels which release carbon dioxide, then more energy goes into the atmosphere than would have otherwise.
3. One author stated that decreased nocturnal cooling may never have been considered in any debate about global warming.
4. While Earth cools much more efficiently at night at the surface, the better cooling does not continue into the upper troposphere very well.
5. The more efficient cooling at night is due almost entirely to the absence of sunlight.
6. During the day, the warming offsets the cooling.
7. Instead of describing the average climate, or even the natural variability of climate, climate change studies try to quantify differences or trends.
8. Much of the interest in studying climate change is motivated by the idea that human activity has changed and will continue to change the climate.
9. When the composition of the atmosphere changes, for example by changing the carbon dioxide concentration, the radiative properties of the atmosphere might also change.
10. We will focus on feedbacks and processes that are thought important in both stabilizing and amplifying changes to the global climate.
11. Conservation of energy means that the total amount of energy does not change, which is equivalent to saying that any energy that is input to the system must be balanced by an outward flux of energy.

Упражнение 10.

Переведите предложения, обращая внимание на перевод герундия.

1. Clearing up air pollution is one of the principal environmental tasks (aims) of a scientist.
2. Cooling may be caused by radiation by contact with cold surfaces, by mixing masses of air of different temperatures.
3. One method of obtaining salt is allowing water to evaporate.
4. The aim of our expedition was exploring the floor of the Pacific Ocean.

5. The process of changing iron ore into iron takes place in a blast furnace (доменная печь).
6. Nobody knew of their having returned from the expedition.
7. When large ice masses reach the warmer lower altitudes they stop advancing and begin to melt.
8. Going from high to low latitudes involves passing from regions of minimum to regions of maximum chemical weathering.
9. One of the most important things is providing information for planning and development of safe arid adequate water supply in locations that will serve as populated areas.
10. If the weight of the ground is increased by its being saturated with water during a period of heavy rains or melting snow, it may result in widespread slides.
11. The size of the crystals in an igneous rock depends on its rate of cooling.
12. After having studied hundreds of sections of rock we may learn the extent of the area over which a bed was deposited.
13. One of the major aims of man is providing information for the development of adequate water supplies in locations that will serve as population areas.
14. Estimating the time that has elapsed since the continental glaciers entirely disappeared from Europe and North America is impossible.

Упражнение 11.

Переведите предложения, обращая внимание на перевод герундия.

1. By analysing the statistical properties of hydroiogic records, such as rainfall or river flow hydrologists can estimate future hydroiogic phenomena.
2. With an understanding of how changes in the environment affect the movement of water, hydrologists can also construct models to predict how these changes will happen in the future.
3. Natural refilling of deep aquifers is a slow process because ground water moves slow through the unsaturated zone and the aquifer.
4. Dams are useful in many ways, such as: providing hydro-electric power; acting as regulator of river flow so as to regulate the occurrence of flooding.

15. Сложные формы инфинитива

В английском языке имеется несколько форм инфинитива:

	Active	Passive
Simple	to use	to be used
Continuous	to be using	
Perfect	to have used	to have been used

Сложные формы инфинитива используются в инфинитивных конструкциях «сложное дополнение» и «сложное подлежащее», а также после модальных глаголов. В конструкциях «сложное дополнение» и «сложное подлежащее» пассивный инфинитив употребляется для обозначения действия, направленного на существительное, образующее данную конструкцию. Например:

In some places ground water appears to be partly confined and, consequently, under some artesian head. Оказывается, что в некоторых местностях грунтовые воды заключены, отчасти, в водоносных пластах и, следовательно, до некоторой степени находятся под артезианским напором.

Перфектный инфинитив обозначает действие, совершившееся раньше, чем действие глагола-сказуемого. Например:

The very high levels of air pollution in parts of Eastern Europe are reported to have caused serious health problems. Сообщается, что очень высокие уровни воздушных загрязнений в ряде местностей Восточной Европы вызвали серьезные проблемы со здоровьем.

Перфектно-пассивный инфинитив обозначает действие, которое уже совершили с существительным, входящим в конструкции «сложное дополнение» и «сложное подлежащее». Например:

The earliest determination of the daily discharge of a natural stream appears to have been made in 1821 for the Rhine River in Switzerland. Оказывается, самое раннее определение суточного расхода естественного потока было выполнено в 1821 г. для реки Рейн в Швейцарии.

Продолженный инфинитив обозначает длительное незаконченное действие, происходящее одновременно с действием, выражаемым сказуемым. Например:

Researchers from Hebrew University found The Dead Sea to be teeming with a type of algae called Dunaliella. Исследователи из

Иерусалимского университета обнаружили, что Мертвое море изобилует одним видом водорослей, называемым зелеными водорослями (фитопланктоном).

16. Инфинитив в функции подлежащего

Если предложение начинается с инфинитива, за которым следует глагол-сказуемое, то этот инфинитив является подлежащим и переводится на русский язык глаголом в неопределенной форме или существительным. Например:

To assess the total water storage on the Earth reliably is a complicated problem because water is so very dynamic.

1.Точно оценить все запасы воды на Земле сложно, так как вода очень динамична.

2.Точная оценка всех запасов воды на Земле – это сложная проблема, т.к. вода очень динамична.

Такой инфинитив вместе с уточняющими словами образует группу подлежащего, заканчивающуюся глаголом-сказуемым (в приведенном примере is).

17. Инфинитив в функции обстоятельства цели и следствия

Инфинитив (или инфинитивная группа с уточняющими ее словами), находясь в начале предложения, может выполнять и другую функцию: он может быть не подлежащим, а обстоятельством цели. Такой инфинитив часто вводится союзом in order (чтобы, для того, чтобы). Например,

In order to control the flow, store water or extract energy dams may be built

.Для того чтобы контролировать поток, накапливать воду или получать энергию, могут быть построены дамбы.

Итак, инфинитив в начале предложения переводится на русский язык либо неопределенной формой глагола (если это инфинитив в функции подлежащего), либо неопределенной формой глагола с союзом *чтобы* (если это инфинитив в функции обстоятельства цели).

Сравните:

To control the flow, store water or extract energy is a difficult problem.

To control the flow, store water or extract energy dams may be built.

Следовательно, обнаружив в начале предложения инфинитив, надо сначала попытаться перевести его, не добавляя союза *чтобы* (в первом примере: «Контролировать поток, накапливать воду и получать энергию – это сложная задача»). Если это не удается (во втором примере), значит, следует добавить союз *чтобы*. «Чтобы контролировать поток, накапливать воду и получать энергию, можно построить дамбы».

Инфинитив в функции обстоятельства цели может находиться не только в начале предложения, но и после дополнения или обстоятельства, причем союз in order и в этом случае опускается. Например:

No definite rule can be given relative to the number of years required to establish a satisfactory average.

Нет единого правила относительно количества лет, необходимых чтобы определить удовлетворительное среднее значение.

Инфинитив в предложении также выполняет функцию обстоятельства следствия и переводится неопределенной формой русского глагола с союзом чтобы (для того, чтобы) после слов enough (достаточно) и too (слишком).

By the early 1980s, some scientists found the risk of climate change great enough to justify an effort to work out preliminary answers.

К началу 1980-х гг. некоторые ученые пришли к заключению, что риски от изменений климата достаточно велики, чтобы оправдать усилия по выработке предварительных решений.

Тренировочные упражнения

Упражнение 1. Переведите предложения на русский язык.

Переведите на русский язык следующие предложения**:**

1. Through geological ages various factors may combine in various ways to produce considerable changes in the relative amounts of insolation received in different parts of the world.
2. The problem is to find the relationship between the observed data and the effect of changing stage.
3. To explain the phenomenon on time was very important.

4. Removal of bogs, swamps and other wetlands in order to produce farmland has reduced the absorption zones for excess water and made floods into sudden disasters rather than gradual increases in water flow.
5. The water in the apple you ate yesterday may have fallen as rain half-way around the world last year or could have been used 100 million years ago by Mama Dinosaur to give her baby a bath.

18. Инфинитивный оборот for + существительное/местоимение + инфинитив

Оборот «*for* + существительное (личное местоимение в объектном падеже) + инфинитив» является в предложении подлежащим, если употребляется после слов *it is necessary / important / possible* и т.п. или обстоятельством следствия после слов too (слишком), enough (достаточно) или обстоятельством цели. Во всех случаях инфинитивный оборот соответствует русскому придаточному предложению с союзом чтобы, а инфинитив в таком придаточном предложении переводится сказуемым. Например:

There must be space between the rock particles for ground water to occur, and the Earth's material becomes denser with more depth.

Для того чтобы грунтовые воды существовали, необходимы поры между частицами горных пород, и с глубиной земные горные породы становится менее пористыми.

Тренировочные упражнения

Упражнение 1. Переведите предложения на русский язык.

1. It is not unusual for the entire summer precipitation to be held in the upper layers of soil as capillary water, or to run off into the streams over the surface of the ground.
2. The information was too scarce for us to rely upon it.
3. It is important for the society to use its resources effectively.

19. Инфинитив в функции определения

Инфинитив или инфинитивная группа, следующие за существительным, могут являться определением к этому существительному.

Инфинитив в функции определения переводится на русский язык различными способами:

1. Инфинитив переводится неопределенной формой русского глагола. Например:

The wish to personally preserve and improve the world, often a strong motivation for those who chose scientific careers, is not restricted to supporters of environmental regulations.

Желание сохранить и усовершенствовать мир, частая сильная побудительная причина для избравших научное поприще, присуще не только сторонникам экологического нормирования.

2. Инфинитиву соответствует в русском языке определительное придаточное предложение, начинающееся словами *который будет* или *который должен*. Сказуемое такого придаточного предложения обозначает действие, которое должно произойти в будущем. Инфинитив, переводимый придаточным предложением, чаще всего имеет пассивную форму (*to be used, to be developed* и т.п.). Например:

There are several key surface features to be considered when making a forecast.

Существует несколько ключевых характеристик поверхности, которые следует принять во внимание при составлении прогноза.

3. Инфинитиву соответствует в русском языке определительное придаточное предложение, начинающееся словами *который может*. Сказуемое такого придаточного предложения обозначает действие, которое можно произвести с определяемым существительным. Инфинитив имеет, как правило, пассивную форму. Например:

Pollution control is largely an engineering problem to be solved by strict laws.Проблема контроля загрязнения – это во многом проблема технического обеспечения, которую можно решить при помощи строгих законов.

Тренировочные упражнения

Упражнение 1. Переведите предложения на русский язык.

1. Snow and strong winds disrupted transportation networks in many parts of the country on 17 December with a warning of more snow to come, according to the Meteorological Agency.

2. The effectiveness of upwelling and its ability to support abundant sea life is greatly dependant upon the depth of the thermocline.
3. Sediment is sorted by current and wave action which generally leave the sand to be transported along the shore to form beach deposits.
4. For some problems in oceanography and air-sea interaction, the surface area and the average depth of adjacent seas are important factors to be considered.
5. A drought is a period of dryness of sufficient length and severity to cause partial or complete crop failure.

Упражнение 2.

Переведите предложения, принимая во внимание различные функции инфинитива.

1. The change in state from liquid to vapour requires energy to be expanded.
2. To maintain a pure water drop of radius 10~7 cm requires a relative humidity of 320%.
3. The process of growth of water droplets is far from simple and much remains to be explained.
4. The gradual process of condensation is inadequate to explain the rates of formation of raindrops.
5. The faster molecules will generally be the first to escape.
6. To evaporate 1 g of water at 0 °C the latent heat of vaporization is 600 calories.
7. Essentially the method is to measure the percolation through an enclosed block of soil with a vegetation cover.
8. The simplest way to visualize the manner in which this deflecting force operates is to picture a rotating disc on which moving objects are deflected.

Упражнение 3.

Переведите предложения, учитывая функции инфинитива.

1. The equator provides the energy supply necessary to drive the planetary atmospheric circulation.
2. The conversion of heat energy into kinetic energy to produce motion must involve rising and descending air.
3. The simplest way to begin to visualize the manner in which this deflecting force operates is to picture a rotating disc on which moving objects are defecting.

4. The distribution of the physical properties of air masses has been shown to be considerably modified.
5. A wind vane to indicate direction should be free from friction.
6. The higher the wind speed the greater the current generated, and the meter is marked to show the wind speed in knots.
7. Admiral Beaufort devised a scale to describe the effect of various wind strengths.
8. The effect of the wind on the surface of the sea was also used by sailors to estimate the wind strength.

Упражнение 4.

Определите функции инфинитива в следующих предложениях и переведите их на русский язык.

1. The earliest attempts to determine the rate of ground-water recharge were probably those of Perralt and Mariotte in the drainage basin of the Seine in the 17th century.
2. In occasional years the runoff may be sufficient to carry the lake through the entire season.
3. Better management plans to make the best use of the available water supply.
4. To efficiency utilize groundwater we must understand its history, where it comes from, where it goes, how much there is and what it is carrying.
5. Though the results of this study obviously have to be generalized it appears that chemical changes in the groundwaters can be related to changes in the geology.
6. In order to determine the maximum yield from a well, results of progressive development work must be evaluated to plot any improvements being made.
7. To provide firm domestic supplies a few 500-gallons tanks were installed.

Упражнение 5.

Переведите предложения, принимая во внимание различные функции инфинитива.

1. If man has built a dam to hinder a river's flow, the lake that forms is a reservoir.

2. It is not always accessible, or fresh enough for use without treatment, and it's sometimes difficult to locate or to measure and describe.
3. Since it is more difficult for the water to go any deeper, it tends to pool in the porous layers and flow in a more horizontal direction across the aquifer toward an exposed surface-water body, like a river.
4. If the aquifers are porous enough to allow water to move freely through it, people can drill wells into the aquifer and use the water for their purposes.
5. Groundwater is believed to provide lubrication and buoyancy which allow thrust faults to move.
6. The temperature of groundwater averages out climactic fluctuations to maintain relatively steady temperature.
7. In many cases, during hot weather, groundwater is cool enough to be used as is, say to be simply pumped through radiators in a home, then returned to the ground in another well.

Упражнение 6.

Переведите предложения, принимая во внимание различные функции инфинитива.

1. The term anthropogenic climate change is used to attribute changes in Earth's climate to activities of humans.
2. Because greenhouse gases absorb infrared radiation, they act to warm the planet.
3. This effect is a useful way to understand the greenhouse effect, and can be easily applied to changing climates.
4. Also, the argument seems to imply that increased nocturnal activity by humans makes the cooling less efficient, but it is an extremely small effect.
5. To derive the temperature, consider the amount of energy reaching the distance from the sun to Earth, i.e. the solar constant.
6. The equations that govern how fluids move in time and space (Navier-Stokes Equations) are complicated to solve, and when all the scales of motion and physical processes (radiative transfer, precipitation, etc) are incorporated, the resulting problem is impossible to carry out analytically.
7. The ultimate goal of climate models is to represent all physical processes that are important for the evolution of the climate system.

8. Climate modeling is limited to truly modeling the system; simplifying assumptions and empirical laws are used, the resolved motions are chosen to match the problem and/or the computing resources, and other processes are parameterized.
9. When the radiative heating of the column brings the lapse rate beyong a critical or threshold lapse rate, a "convective adjustment" is used to reduce the instability.
10. To verify their own climate model calculations, the researchers first simulated the climate of the last century and compared the results with the real climate.
11. Some people, for a variety of reasons, claim to have found faults with the hypothesis that humans are affecting Earth's climate.

Упражнение 7.

Переведите предложения, принимая во внимание различные функции инфинитива.

1. To help them better convey forecasts and warnings in a clear, targeted and effective manner, workshop participants have been receiving guidance in modern presentation techniques used in television, radio, newspapers and on the Internet. The main objective is to alert people to weather conditions in Thailand in a timely and easily understandable fashion.
2. The meeting aims to improve observing systems, data-processing and forecasting systems, public weather services, telecommunication systems, and other components of the WWW for efficient and effective exchange and dissemination of data and information, including early warnings.
3. On 7 December 2005, Mr Suparerk Tansriratanawong, Director-General of the Thai Meteorological Department (TMD), signed an agreement with the national TV channel to provide weather forecasts to the public.
4. To be sure, knowledge of aerosols was so uncertain, and the normal fluctuations in climate were so great, that the volcano "experiment" could not prove anything for certain.
5. They continued to offer hand-waving models to suggest how the interaction might behave.

6. Any tiny initial error in the physics or climate data tended to accumulate, adding up through the millions of numerical operations to give an impossible final result.
7. It was good enough to confirm the long-held assumption that ice and snow albedo were indeed important for sustaining an ice age.
8. This program was largely overtaken by much more detailed data deduced from studies of ocean floor mud, data precise enough to combine with computer models of climate.
9. Monitoring programs are required to detect and measure changes in biodiversity, to better understand functional linkages in ecosystems and to evaluate the success or failure of conservation and sustainable use policies and programs.
10. Effective monitoring programs must be integrated and ecologically-based in order to determine and implement appropriate management practices.
11. Environmental protection is an issue of interest to many people with both converging and diverging interests to uphold.
12. The dynamic that exists between the general public, politics and the economic community is not easy to coordinate.
13. It must also be flexible enough to be able to respond to new challenges such as climate change, which could result in changing groundwater levels and unexpected stresses on the groundwater resource.
14. Experts in urban climatology will be meeting in Goteborg, Sweden, 12-16 June 2006, to discuss application of knowledge of the atmosphere and urban environments for the better design and operation of settlements.

Упражнение 8.

Переведите предложения, принимая во внимание различные функции инфинитива.

1. Recent decades could not be called normal by any standard of the past, and he saw no reason to expect the next decades would be "normal" either.
2. Hundreds of thousands of earthquake survivors still require shelter and food to help them endure what has been forecast as a bitter winter.
3. With air moving away from this region, air must sink from above to replace it.

4. There are several different methods that can be used to create a forecast.
5. "There is nothing to suggest that an end to the speculation on climatic change is in sight," he sighed. "It seems that we have a long way to go before the correct answer can be affirmed."
6. By the mid 1970s, everyone understood that it was hopeless to try to understand how climate changed by looking at just one or another feature, or even several features: you had to take into account all the mutually interacting forces at once.
7. Relying not only on his computer model work but also on elementary physical arguments, he explained that global warming was liable to bring more frequent storms and floods as well as life-threatening heat waves.
8. Although those campaigns had been discredited after a decade or two, fair-minded people were ready to listen to the global warming skeptics.
9. Further speculations came from amateur meteorologists, who were not yet easy to distinguish from professionals.
10. It is usual to estimate the quantity of water found in the so-called hydrosphere.
11. Based on water exchange characteristics, two concepts are often used in hydrology and water management to assess the water resources in a region: the static storage component and the renewable waters.
12. In practice, it is the value of river runoff that is used to estimate water availability and/or deficit in water resources for this or that region.
13. Infiltration constitutes the sole source of water to sustain the growth of vegetation and it helps to sustain the ground water supply to wells, springs and streams.
14. Observations of hydrologic processes are used to make predictions of future water movement and quantity.

20. Инфинитивная конструкция «сложное дополнение»

Предложение с этой конструкцией строится по следующей схеме:

Подлежащее + Сказуемое + Сложное дополнение,

при этом сложное дополнение представляет собой существительное или местоимение в объектном падеже + инфинитив.

Конструкция «сложное дополнение» употребляется после сказуемого, выраженного следующими глаголами: *would like, to want* – хотеть, *to know* – знать, *to think* – думать, *to believe* – считать, полагать, *to consider* – считать, *to suppose* – полагать, считать, *to presume* – полагать, допускать, *to expect* – ожидать, предполагать, *to find* – находить и некоторыми другими в действительном залоге.

На русский язык «сложное дополнение» переводится придаточным предложением с союзами что, чтобы, при этом инфинитив английского предложения передается сказуемым русского предложения. Например:

We at first do not consider water to be an unusual substance, since it seems the most common one that exists on the earth. На первый взгляд нам не кажется, что вода – это нечто необычное, т.к. она является самым распространенным веществом на земле.

Конструкция «сложное дополнение» употребляется, кроме того, после глаголов *let* – позволять, разрешать и *make* – заставлять. В этом случае инфинитив стоит без частицы *to*.

21. Инфинитивная конструкция «сложное подлежащее» при сказуемом в страдательном залоге

Эта конструкция строится по следующей модели:

Подлежащее + Сказуемое + Инфинитив.

В качестве сказуемого в этой конструкции используются такие глаголы, как *to know* – знать, *to say* – говорить, *to think* – думать, *to believe* – полагать, *to consider* – считать, полагать, рассматривать, *to expect* – ожидать, предполагать, *to report* – сообщать, *to suppose* – предполагать, *to find* – находить, *to assume* – предполагать, допускать, *to presume* – полагать, допускать. Например:

Great temperature ranges are assumed to be characteristic of broad plateaus except near the equator.

a) Большие диапазоны температур, как полагают, характерны для обширных плато, за исключением областей вблизи экватора.

b) Предполагается, что большие диапазоны температур характерны для обширных плато, за исключением областей вблизи экватора.

Следовательно, инфинитив в английском предложении, содержащим эту конструкцию, следует переводить сказуемым, а сказуемое английского предложения либо вводными словами (как известно, как считают), либо неопределенно-личным предложением с последующим союзом *что* (известно, что, считают, что... и т.д.).

Тренировочные упражнения

Упражнение 1.

Переведите предложения на русский язык.

1. Subsurface water on Mars is believed to have given rise to some of the landforms observed there.
2. Local thunderstorms of marine origin are known to be most frequent in early morning hours.
3. The prediction is believed to be the more accurate the nearer the two gages are together.
4. High energy conditions will significantly change coast lines that are predominantly depositional and may be expected to cause considerable erosion along the coastal region where this process is dominant.
5. The very high levels of air pollution in parts of Eastern Europe are reported to have caused serious health problems.

22. Инфинитивная конструкция «сложное подлежащее» при сказуемом в действительном залоге

Конструкция «сложное подлежащее» употребляется с рядом глаголов и выражений, включающих глагол в действительном залоге, а именно*: to seem, to appear* – казаться (их можно также переводить вводным словом *по-видимому*), *to prove, to turn out* – оказаться, *to happen* – случаться, *to be likely* – вероятно, *to be unlikely* – маловероятно, вряд ли, *to be certain, to be sure* – несомненно, наверняка, безусловно. Например:

These temperature changes appear to be in general accordance with accompanying changes in pressure distribution and winds.

По-видимому, эти изменения температуры находятся в полном соответствии с сопровождающими их изменениями в распределении давления и ветра.

Тренировочные упражнения

Упражнение 1.

Переведите предложения, содержащие объектный и субъектный инфинитивные обороты.

1. We know condensation to occur with great difficulty in clean air.
2. These particles are known to be dust, smoke, salts, etc.
3. Cloud droplets are likely to be the immediate sources of raindrops.
4. Cooling takes place because adiabatic expansion causes energy to be consumed through work.
5. The air in advance of the depression is most likely to be the coldest.
6. The distribution of the physical properties of air masses has been shown to be considerably modified.

Упражнение 2.

Переведите на русский язык следующие предложения.

1. The humidity on the east side of the valley is believed to be higher than on the west side.
2. The earth was believed to be too impervious to permit penetration of the rain water far below the surface.
3. Certain valleys that had contained glaciers several miles in length proved to be unglaciated at their heads, the latter being too shallow, only 100 feet or less deep.
4. The cutting of the timber is believed to have had the general effect in many parts of the country.
5. Artesian wells are likely to have fluctuations that are due to pressure effects.
6. The origin of springs is always appeared to be mysterious.
7. The water of the Warm Springs in Georgia is believed to come from surface sources.
8. In some places ground water appears to be partly confined and, consequently, under some artesian head.

Упражнение 3.

Переведите предложения, принимая во внимание различные функции инфинитива.

1. The ocean is heated from above, which tends to suppress convection.

2. At one time, it was believed that evaporation/precipitation was a major driver of ocean currents; it is now known to be only a very minor factor.
3. The ocean body surrounding the Antarctic is currently the only continuous body of water to circumnavigate the globe about the polar axis.
4. Tidal resonance occurs in the Bay of Fundy since the time it takes for a large wave to travel from the mouth of the bay to the opposite end, then reflect and travel back to the mouth of the bay coincides with the timing between this repeating wave that is also reinforced by the tidal rhythm producing the world's highest tides.
5. Liquid water is thought to be present under the surface of several natural satellites, particularly the Galilean moons of Europa, and, with less certainty, Callisto and Ganymede. Geysers have been found on Enceladus.
6. Liquid hydrocarbons were thought to be present on the surface of Titan, though it may be more accurate to describe them as "lakes" rather than an "ocean".
7. During the Egyptian conquest it is said that Queen Cleopatra obtained exclusive rights to build cosmetic and pharmaceutical factories in the area.
8. Because it is not realistic to cease using the Jordan River for human needs, one idea to save the Dead Sea is to bring in water from the Mediterranean or Red Sea, either through tunnels or canals.
9. On May 9th, 2005, Jordan, Israel, and the Palestinian Authority signed an agreement to begin feasibility studies on the project—to be officially known as the 'Two Seas Canal".
10. To extend this definition far from land means comparing the local height of the mean sea surface with a "level" reference surface, or datum, called the geoid.
11. A surface wave, in this sense, has a wavelength that is too short to propagate freely in the less dense medium.

23. Неполные придаточные предложения

Группа слов, состоящая из союзов *when, while, if, until, unless* и т.д. и причастия, прилагательного и (редко) существительного, рассматриваются как неполные придаточные предложения. Например:

When carried out last year, the experiment showed good results. Здесь опущено подлежащее (то же, что и в главном предложении – the experiment и вспомогательный глагол was). При переводе на русский язык подлежащее восстанавливается: «Когда эксперимент проводился в прошлом году, он показал хорошие результаты».

Тренировочное упражнение

Упражнение 1.

Переведите на русский язык следующие предложения.

1. Where cleared, the deciduous forest tends to be replaced by rich green grassy meadows.
2. Most geological processes are very slow and geologic time is exceedingly long especially when measured by the scale of human history.
3. When freezing water expands by about one tenth its volume.
4. Limestone when mixed with clay may provide good soils.

24. Условные предложения

Условные предложения в английском языке вводятся союзами *if* – если, *provided* – если, при условии, что, *unless* – если не. После этих союзов будущее время глаголов заменяется настоящим. Например:

If a given mass of air is heated to a higher temperature than the surrounding air, it expands and becomes less dense.

Если данная масса воздуха нагревается до более высокой температуры, чем окружающий воздух, она расширяется и становится менее плотной.

Если же в главном предложении употребляются глаголы should или would, а в условном предложении сказуемое употреблено в простом прошедшем времени, то на русский язык и главное и придаточное предложения переводятся с частицей бы. Такие предложения относятся к настоящему или будущему времени. Например:

If there were no greenhouse gases in the atmosphere, the Earth would be a cold and lifeless planet with an average atmospheric temperature of –18 °C.

Если бы в атмосфере не было парниковых газов, Земля была бы холодной и безжизненной планетой со средней температурой –18 ºС.

Если в состав сказуемого условного придаточного предложения входят глагольные формы *were, had, could, should*, они могут занимать место перед подлежащим, и союзы в таких предложениях не употребляются:

Had the continents at one time been united, this should be indicated in the rocks that were formed prior to the breakup.

Если бы материки когда-то составляли единое целое, это нашло бы отражение в горных породах, которые сформировались до их распада.

Should the salinity within the cells of an organism be less than that of the external medium, water from the cells would pass through the cell membranes into the external medium.

Если бы соленость в клетках организма была меньше, чем соленость внешней среды, вода из клеток проходила бы через клеточные мембраны во внешнюю среду.

Когда сложное предложение с условным придаточным предложением относится к прошлому, то в главном предложении после глаголов *should, would* или *could* стоит перфектный инфинитив, а в условном предложении сказуемое употребляется в Past Perfect. Например:

If the earth's primitive atmosphere had resulted from volcanic gases, it couldn't have contained free oxygen because free oxygen is not emitted during this process.

Если бы первичная атмосфера Земли произошла от вулканических газов, она не могла бы содержать свободный кислород, т.к. во время этого процесса свободный кислород не выделяется.

Тренировочные упражнения

Упражнение 1.

Переведите на русский язык следующие предложения.

1. If present day glaciers were to melt and release their storage of water, sea level would rise by several tens of meters and submerge many heavily populated coastal areas.

2. If it were not for beach drift and long shore currents, many beaches would be nearly sandless.
3. Without carbon dioxide and methane current temperatures in northern parts of North America and Europe would be cooler by 3 or 4 degrees Celsius and incipient ice age would have begun several thousand years ago.
4. If we could provide seasonal or longer climate outlooks with 100% reliability, there would be little need for the use of past weather and climate data.
5. Were the Earth a colder object like Pluto, it would not matter how much water there was on the planet, it would all be frozen. On the other hand, were we on a very hot planet, all of the water would be in a gaseous state.

Упражнение 2.

Переведите предложения на русский язык.

1. In many places, if you looked at a vertical cross-section of the earth you would see that rock is laid down in layers, especially in areas of sedimentary rocks.
2. If you stopped adding water, the top sponge would dry up and, as the water dripped out of the bottom sponge, it would dry up too.
3. If all bedrock consisted of a dense material like solid granite, then even gravity would have a hard time pulling water downward.
4. If only man could suddenly stop contaminating rivers, then with time water could return to its natural purity.
5. If the aquifer that underlies the High Plains of Texas and New Mexico – an area of slight precipitation – was emptied, it would take centuries to refill the aquifer at the present small rate of replenishment.
6. Even if we take the total energy from the solar constant spread over the full surface area of Earth, the emission must be in the infrared.

Упражнение 3.

Переведите следующие предложения на русский язык.

1. If no attempt is made to measure the velocity in the low-velocity layer directly, depth calculations should be made by the critical distance method.

2. If the problem is complex, it is wise to analyze the data by several different methods as one method may complement another and bring out points that would not be noticed in a single approach.

3. If a given mass of water could be pulled away from a given mass of soil, a certain amount of work would be required.

4. If frost is present at a high moisture content, it will reduce infiltration and increase surface runoff.

5. If the stream rises rapidly its surface may temporarily be above the adjacent water table.

6. If the weather turns cold there is no surface storage of snow.

7. If there were no intake or recharge the ground-water systems would gradually run down.

8. If the river storage had fallen below the intake, a secondary intake could have been used, but the city would have only a 24-hr supply unless emergency actions were taken.

9. Spring pools that do not have enough head to discharge water at the surface, are, strictly, not springs at all. If they are associated with pools that discharge they are commonly regarded as springs; if they are not near true springs, are deep and deep-sided, they may be called natural wells, if their sides are less precipitous and they have relatively large water surfaces they are regarded merely as ponds or lakes.

Упражнение 4.

Переведите предложения на русский язык.

1. If we know the rate at which oxygen is used up in the water it would be possible to estimate the flow speed.
2. At first sight it might seem appropriate to liken these two gyres.
3. It should be noted that the ranges of salinity and temperature found are much less.
4. As the waves move inshore and slow down, not only does the wavelength decrease but also the wave height changes.

25. Значения слов *would/should*

Would используется в английском языке:

1) В предложениях будущего времени косвенной речи, когда слова автора стоят в прошедшем времени (по правилу согласования времен):

We decided that this question would have to await further research.

Мы решили, что этому вопросу необходимо дальнейшее исследование.

2) В сослагательном наклонении (бы):

The disappearance of Earth's ice cover would significantly alter the global climates.

Исчезновение ледяного покрова Земли привело бы к значительному изменению мирового климата.

В этих двух значениях наряду с *would* может использоваться *should*, в частности, если подлежащее выражено местоимением 1 лица (*I, we*).

3) Для передачи вежливых просьб, предложений, приглашений: Would you mind putting it in writing?

Напишите это, пожалуйста.

I'd like (would like) an orange, please.

Можно мне апельсин?

4) Для передачи повторяемости действия в прошлом, которое уже не имеет место сейчас (при этом *would* переводится *раньше, бывало*):

About 8,000 years ago the greenhouse gases stopped following the pattern that would be predicted from their long-term behavior.

Около 8000 лет назад парниковые газы перестали следовать той схеме, которая раньше предсказывалась по их долговременному поведению.

Should является также одним из модальных глаголов и употребляется в значении *следует, должен*:

Carbon dioxide is an important heat-absorbing gas, and an increase of its content should lead to higher atmospheric temperatures.

Углекислый газ является важным газом, поглощающим тепло, и увеличение его содержания должно привести к более высоким температурам.

Тренировочные упражнения

Упражнение 1.

Переведите на русский язык следующие предложения.

1. At some time in the future the hydrogen supply of the sun will begin to run low, then a new ice age would be another catastrophe of slow kind.
2. The temperature equilibrium established between surface seawater and the air above it should mean that changes in the climate should

be reflected in the changes in organisms living near the surface of the deep sea.

3. An extensive glaciation of the planet would cause considerable lowering of the sea level which in turn would uncover millions of square miles of new land in nonglaciated areas.
4. Milder winters in the middle of high latitudes means greater snowfall while cooler summers would bring a reduction in snowmelt.
5. And it was clear long ago that the part of carbon dioxide that went into the ocean would fundamentally alter the chemistry of the seawater.

Упражнение 2.

Переведите предложения, учитывая различные значения глаголов *should, would.*

1. If the same meteorological event happened this winter, the smog would contain "only" 210 tons of smoke.
2. Suppose we have a roomful of very bad London fog as a specimen, this room would contain the combustion products: carbon monoxide, smoke, sulphur dioxide, hydrochloric acid and fluorine.
3. To pump in fresh air would require a pumping rate of 200,000 tons per minute.
4. To raise the air temperature in London by 1°C an hour would require 3 million megawatts.
5. It should be noted that wind speed is usually recorded in knots or as a Beaufort force.
6. Had a wave cloud been supercooled and become frozen the ice crystals would not have evaporated.
7. It should be borne in mind that condensation occurs with utmost difficulty in clean air.
8. It was originally thought that atmospheric turbulence by making cloud particles collide would cause a significant proportion to coalesce.
9. Had the air been cooled at constant pressure without addition or removal of vapour saturation would occur.
10. It was also suggested that large drops would grow at the expense of small ones.
11. In the absence of an atmosphere, the longwave radiation emitted to space would be exactly equal to the shortwave absorbed, and the surface temperature would be a chilly 255 K.

12. In the absence of an atmosphere, Earth would look a lot like a black body radiator; that is to say, the sun would shine on Earth, which would warm to an equilibrium temperature, and then a balance would be struck.
13. We cannot possible represent every atom in the climate system, it would essentially take the same number of electrons in the computer.

Упражнение 3.

Переведите следующие предложения на русский язык, обращая внимание на употребление глаголов *should, would, might*.

1. In many instances it would be desirable to determine the most important characteristics of an aquifer.
2. Aquifer analysis should be based on as many methods available, that are applicable to the test data.
3. This procedure should be routine in the western Canadian plains because there is generally some dip.
4. The period required to eliminate the holdover effect of extremely wet and extremely dry years should also be studied.
5. It might be thought that the regional snow line would coincide with the highest level to which the snow cover retreats at the end of the melting season.

Упражнение 4.

Переведите на русский язык, обращая внимание на использование would.

1. But 300 million years ago the land-masses that would later turn into North and South America, Africa and Eurasia first came together to form the supercontinent and then broke up.
2. It was obvious to us that even through a single leaf or plant made only tiny amounts of methane, these small bits would add up quickly because plants cover a substantial part of the globe.
3. If the temperature were the sole factor to determine whether or not a rock melts, the earth would be a molten ball covered with only a thin solid outer shell.
4. Without carbon dioxide and methane in the atmosphere current temperatures in the Northern parts of North America ad Europe would be cooler by 3 or 4 degrees Celsius.

5. A buildup of one or several gases in the atmosphere would slow down in the escape of heat into space and lead to an increase in the average temperature of the earth's atmosphere.
6. A doubling of the preindustrial CO_2 level of around 273 ppm to 550 ppm would raise the average atmospheric temperature by about 4 degrees Celsius.
7. The annual cost of electricity could increase by at least 1 billion dollars if the accuracy of weather forecasts improved by one degree.
8. On one hand, the presence of thick clouds should inhibit diabatic cooling and mitigate against downward motion. On the other hand, precipitation from decaying tropospheric anvils would cause diabatic cooling due to evaporation below the clouds.

Упражнение 5.

Переведите на русский язык, обращая внимание на сослагательное наклонение.

1. It's likely that fewer stars would have formed and a higher fraction of our universe's mass would still be in a gaseous state.
2. In 2001 no scientist would have factored in direct emissions of methane by plants because no one suspected that biological production of methane was possible.
3. The methane emissions by the plants have contributed to the natural greenhouse effect without which life wouldn't be possible.
4. As we can expect methane emissions from vegetations to increase with temperature, this would lead to even more warming.
5. We would expect that in an area of the ocean/atmosphere interface the average temperature of the surface water of the ocean would approximate that of the contiguous atmosphere.
6. The importance of CO_2 lies in the fact that it traps the portion of the radiation emitted by the earth and thereby keeps the air near the earth's surface warmer than it would be without CO_2.
7. It wouldn't be amiss if we mention another version of the Caspian birth.
8. The advancing Indian plate, acting as what physicists would call a rigid indentor, has continually forced part of the Eurasian lithosphere out of its way.

Тест 1

Задание 1.

Найдите в тексте из задания 2 примеры этих частей речи.

v.	n.	adj.	adv.	prep.

Задание 2.

Переведите текст. (Контрольное время – 15 минут)

Snow melt is exactly analogous to rainfall with respect to supply of water for infiltration and runoff, except for the relatively small storage and lag of the melted snow in the snow cover. During periods of no precipitation, successive differences in a series of daily measurements of water equivalent of a melting snow cover are practically analogous to daily increments of rainfall. Ordinary measurements of incremental changes in water equivalent of the snow cover are not satisfactory measurements of snowmelt, largely because of the inherent observational and sampling errors. Taking cores from successive locations at a site confounds variation in time with variation in space. Two additional and compelling reasons exist for estimating, instead of observing, snowmelt. One is in forecasting streamflow, where it is advantageous to forecast the causes of melt instead of merely waiting for the resulting melt. The other reason, particularly for design and planning, is the need to extrapolate extreme melting rates on the basis of physical process.

Задание 3.

Найдите все подлежащие и сказуемые в следующих предложениях:

a) In many heavily populated coastal areas human activities are increasingly threatening the abundance of plant and animal life in estuaries and coastal wetlands and destroying some of the important services these ecosystems provide.

b) Generally these correlations are made between snowmelt and aspects of air temperature, although it is clear from the preceding discussion that due to the variation in the various heat transfer processes no single index or method of estimating snowmelt will be applicable to all areas and for all weather conditions.

a) подлежащее
   сказуемое
b) подлежащее
   сказуемое

Задание 4.

Найдите в тексте и выпишите все прилагательные. Напишите все 3 степени сравнения встретившихся вам прилагательных. Все ли прилагательные имеют сравнительную и превосходную степень?

Задание 5.

Выпишите из текста все наречия с окончанием *-ly*. Образуйте прилагательные от данных наречий.

Задание 6.

Переведите следующие словосочетания:

Temperature profile changes, sound speed minimum, water storage capacity, world precipitation maps, fossil fuel combustion, total sediment weight per unit time, water vapour density, excess nutrients, pollution control equipment, water resource assessment problems, sediment particle size, narrow beam infrared sensor.

Задание 7.

Используйте подходящую видовременную форму глагола.

a) Flood measurements on large rivers (make) best from bridges, cableways or boats.
b) Beginning in 1700, societal changes brought by the Industrial Revolution (increase) the amount of carbon dioxide entering the atmosphere.
c) This year some indications (find) of the southward flow to about lat. 23 N, but no clear evidence for a boundary current flow (be) available between there and the equator.
d) The final result of this process (depend) on the conditions under which it (take) place.
e) The quality of surface water and air partially (improve) after the independence of the country, but the quality of some ground waters (continue) to deteriorate.

f) Since early times seamen (watch) the changes in sea and sky.
g) Density (affect) by the temperature and with most substances we observe that a decreased temperature (produce) an increase in the density of the substance.

Задание 8.

От глаголов в скобках образуйте причастие 1 или 2 рода.

a) The amount of heat energy (add) to the atmosphere by the green-house effect is (control) by the concentration of greenhouse gases in the Earth's atmosphere.
b) It is no wonder that a flood can have such a far (reach) impact with the enormous power of water (run) wild in nature.
c) Recent events must be (view) in the context of long-term, natural processes as well as the relatively short-term body of data (collect) since the Industrial Revolution.
d) Total fresh water (consume) increased to 100 billion gallons per day, with irrigation in the western states (account) for about 80% of the total (consume).
e) This simple general pattern is modified by a number of other factors (include) (unexplain) or random variations in the global atmospheric circulation.

Задание 9.

Переведите следующие предложения.

f) Given the increasing usage and pollution of water sources by puman activities, it may be argued that the problems of water quality are now often more difficult and demanding than **those** of water quality.
g) Whatever the reason for the transposition, **there is** no indication of this boundary current on transatlantic sections at and north of this latitude.
h) **There are** many pathways the water may take in its continuous cycle of falling as rainfall or snowfall and returning to the atmosphere.
i) **One** should know the difference between these two systems.
j) Ocean currents are the result of thermohaline motions as well as wind-driven **ones.**
k) Note that the resultant direction of motion in the open sea is not the same as **that** of the wind.

Задание 10.

Определите, в каких предложениях:

a) НПО в начале предложения;

b) НПО не в начале предложения;

c) НПО отсутствует.

1. Convection refers to the transformation of air in a vertical direction, the warm air rising and the cold air falling.
2. Isobars crossing fronts should be drawn with sharp bends, with kinks pointing to higher pressures.
3. The fog having vanished for some moments, it proved possible to determine the position of the ship.
4. Ice was sighted floating at sea having been formed either upon the salt water itself or upon the land.
5. The velocity of the tidal current decreases from the surface to the bottom, the velocity-near the bottom being about two thirds that at the surface.

Задание 11.

Переведите следующие слова

Annual, tiny, hence, aid, supply, to regard, frequently, obtain, occur, several, expect, to fill, nevertheless, glacier, exist, although, duration, either...or, exchange, result from, since, assist, temporary, less, to estimate, approach, spread, vary, mean (adj.), to reach, according to, waste, prevail, offer, to cause, main, to include, by means of, benefit, even, to refer to, the same, few, to be available, for instance, to carry out, relationship, quantity, to distribute, to evaporate, therefore, to lead, lead, in turn.

Тест 2

Задание 1.

Найдите в тексте из задания 2 примеры этих частей речи.

v.	n.	adj.	adv.	prep.

Задание 2.

Переведите текст. (Контрольное время – 15 минут)

Most of water's usefulness results from its unique physical properties compared to those of other molecules of similar weight. Liquid water has a high boiling point of 100°C (212°F) and solid water has a high melting point of 0°C (32°F). Otherwise, water at normal temperatures would be a gas rather than a liquid and the earth would have no oceans, lakes, rivers, plants, and animals. Liquid water has a very high heat of vaporization. This means that water molecules absorb large quantities of heat when they are evaporated by solar energy from bodies of water and release large amounts of heat when atmospheric water vapor condenses and falls back to the earth as precipitation. This ability to store and release large amounts of heat during physical changes is a major factor in distributing heat throughout the world. This property also means that evaporation of water is an effective cooling process for plants and animals—explaining why you feel cooler when perspiration evaporates from your skin.

Задание 3.

Найдите все подлежащие и сказуемые в следующих предложениях:

a) This property also means that evaporation of water is an effective cooling process for plants and animals – explaining why you feel cooler when perspiration evaporates from your skin.
b) These properties along with water's solvent ability allow plants to receive nutrients from the soil, thus supporting the growth of plants and the animals that feed on them.

a) подлежащее
   сказуемое
b) подлежащее
   сказуемое

Задание 4.

Укажите предложения, не содержащие условия.

1. Had the altimeter been accurate, it would have measured the pressure correctly.
2. Were the wind stronger, the instruments would be destroyed.
3. Wind velocity would increase rapidly under these conditions.
4. It is necessary that the new equipment should be tested thoroughly
5. Should temperature drop, condensation would result.

Задание 5.

Укажите предложения, в которых сказуемое выражено глаголом в форме сослагательного наклонения.

1. It is important to find the exact mechanism of the heat balance.
2. To ensure uniform water temperature the liquid should be stirred.
3. But for the turbulent diffusion, the air near the ground would become saturated and evaporation would stop.
4. If the earth were a uniform land surface without an atmosphere, the temperature of the surface at any given place would be governed directly by the amount of insulation received there.

Задание 6.

Укажите правильный перевод предложения.

1. Should the raindrops pass through zones of temperature below freezing, hail would result:

а) Если дождевые капли пройдут через зоны с температурой ниже нуля, может образоваться град

б) Если бы дождевые капли прошли через зоны с температурой ниже нуля, то образовался бы град.

в) Дождевые капли должны пройти через зоны с температурой ниже нуля. В этом случае образуется град.

г) В случае, если дождевые капли прошли через зоны с температурой ниже нуля, образовался град.

2. Were there no particles of this kind in the air, there would be no natural condensation:

а) Если в воздухе будут находиться частицы подобного вида, произойдёт естественная конденсация.

б) Если бы в воздухе не было частиц подобного вида, естественной конденсации не произошло бы.

в) Если в воздухе не будет частиц подобного вида, естественная конденсация не произойдет.
г) Если бы в воздухе были частицы подобного вида, произошла бы естественная конденсация.

3. But for the combination of warm weather and rain there would be no severe floods on this stream:
а) Если бы не сочетание тёплой погоды с дождём, на этой реке не было бы сильных наводнений.
б) Несмотря на сочетание теплой погоды с дождем на этой реке не будет сильных наводнений.
в) Если бы теплая погода сочеталась с дождём, на этой реке не было бы сильных наводнений.
г) Если бы дождь не сочетался с теплой погодой, на этой реке были бы сильные наводнения.

Задание 7.

Укажите предложение, в котором условие реальное.

1. If the earth were all uniform the isotherms would be similar to the parallels or latitude
2. If the wind were favorable, the ship would reach the port of destination early in the morning.
3. If several rains passed a serious flood would result.
4. If several rains had passed, a serious flood would result.
5. If several rains pass, a serious flood will result.

Задание 8.

Укажите предложение, в котором сказуемое выражено глаголом в форме изъявительного наклонения.

1. Were it not for the protective ozone layer life upon the earth might have been impossible.
2. Nine bergs were sighted; several more would have been seen if the greater part of this run had not been made at night.
3. If the ground were saturated with water, there could be no further infiltration.
4. The explorers were terrified lest the ice-floe should break.
5. It is advisable that rainfall observations should be received from several stations.

Задание 9.

Определите, каким членом предложения или его частью является инфинитив:

а) обстоятельством;

б) именной частью сказуемого;

в) определением;

г) частью сложного глагольного сказуемого;

д) подлежащим.

1. To prevent the overflow of the river is an urgent task.
2. One way of obtaining hydrogen is to pass electric current through water.
3. To ensure uniform water temperature, the liquid should be stirred.
4. To give a true picture of the surrounding matter is the task of natural science.
5. The methods to be described are used in our laboratory.
6. Water is to be purified to meet our needs.
7. We'll employ this computer to get reliable data.

Задание 10.

Укажите английское предложение, соответствующее данному русскому.

1. Оказалось, что циклон двигался с запада на восток.

a) The cyclone seems to move from west to east.
b) The cyclone was moving from west to east.
c) The cyclone seemed to be moving from west to east.

2. Учёные полагают, что солнечные пятна влияют на погоду

a) Scientists believed that sunspots affected weather
b) Scientists believe weather to affect sunspots,
c) Scientists believe weather to be affected by sunspots,

3. Оказалось, что течение изменило своё направление.

a) The current has changed its direction.
b) The current was seen to have changed its direction.
c) He saw the current to have changed its direction.

Задание 11.

Укажите предложения, содержащие:

а) объектный оборот;

б) субъектный оборот.

1. The information is used to study the distribution of rainfall over the country.
2. In this case the wind is said to have hurricane force.
3. The professor wanted the students to repeat the experiment under field conditions.
4. The hydrologic cycle is known to include several phases.
5. The diagram shows the current to have changed its direction.

Задание 12.

Переведите предложения, обращая внимание на перевод слова for

1. A datum for the level of the present and future floodings was fixed.
2. We had watched our barometer falling gradually for several days, but we did not expect rain to reach us, imagining that we were too far north.
3. Icebergs often move in the opposite direction to the pack ice, for they are carried by currents and are less influenced by the wind.

Приложение А

Таблица неправильных глаголов

		Past Simple	Participle II	
1	be	was, were	been	быть, являться
2	bear	bore	bom	родить
3	become	became	become	сделаться, стать
4	begin	began	begun	начинать
5	blow	blew	blown	дуть
6	break	broke	broken	ломать
7	bring	brought	brought	приносить
8	build	built	built	строить
9	burn	burnt	burnt	гореть, жечь
10	buy	bought	bought	покупать
11	catch	caught	caught	ловить
12	choose	chose	chosen	выбирать
13	come	came	come	приходить
14	cost	cost	cost	стоить
15	cut	cut	cut	резать
16	dig	dug	dug	рыть, копать
17	do	did	done	делать
18	draw	drew	drawn	тащить; рисовать
19	dream	dreamt	dreamt	мечтать; видеть во сне
20	drink	drank	drunk	пить
21	drive	drove	driven	водить машину
22	eat	ate	eaten	есть, кушать
23	fall	fell	fallen	падать
24	feed	fed	fed	кормить
25	feel	felt	felt	чувствовать
26	fight	fought	fought	бороться, сражаться
27	find	found	found	находить
28	fly	flew	flown	летать
29	forget	forgot	forgotten	забывать
30	get	got	got	получать

31	give	gave	given	давать
32	go	went	gone	идти, ходить
33	grow	grew	grown	расти, становиться
34	have	had	had	иметь
35	hear	heard	heard	слышать
36	hide	hid	hidden	прятать
37	hold	held	held	держать
38	keep	kept	kept	держать, хранить
39	know	knew	known	знать
40	lead	led	led	вести
41	learn	learnt	learnt	учить
42	leave	left	left	оставлять, покидать
43	lend	lent	lent	давать взаймы
44	let	let	let	позволять
45	lose	lost	lost	терять, проигрывать
46	make	made	made	делать
47	mean	meant	meant	значить
48	meet	met	met	встречать
49	put	put	put	класть
50	read	read	read	читать
51	ride	rode	ridden	ездить верхом
52	rise	rose	risen	подниматься
53	run	ran	run	бежать
54	say	said	said	сказать
55	see	saw	seen	видеть
56	sell	sold	sold	продавать
57	send	sent	sent	посылать
58	set	set	set	помещать; устанавливать
59	shine	shone	shone	сиять, блестеть
60	sing	sang	sung	петь
61	sink	sank	sunk	погружаться
62	sit	sat	sat	сидеть
63	sleep	slept	slept	спать
64	smell	smelt	smelt	нюхать, пахнуть

65	speak	spoke	spoken	говорить
66	spend	spent	spent	тратить, проводить
67	spoil	spoilt	spoilt	портить
68	spread	spread	spread	распространять
69	stand	stood	stood	стоять
70	swim	swam	swum	плавать
71	take	took	taken	брать
72	teach	taught	taught	обучать
73	tear	tore	torn	рвать
74	tell	told	told	сказать
75	think	thought	thought	думать
76	throw	threw	thrown	бросать
77	understand	understood	understood	понимать
78	wear	wore	worn	носить, изнашивать
79	win	won	won	выигрывать
80	write	wrote	written	писать

Приложение Б

Наиболее распространенные служебные слова

although – хотя
as – так как; когда; по мере того как; как
as well as – так же, как и
as soon as – как только
as long as – до тех пор пока
as ... as – так же ... как; такой же ... как
as ... as possible – как можно ...
not so (as) ... as – не так ... как, не такой ... как
as to / for – что касается
so as + инфинитив – так чтобы
the same as – такой же, как
after – после того как (*как* предлог *after* означает *после*)
because – потому что
because of – из-за
before – до того как (*как* предлог *before* означает *до*)
for – так как; ибо (*как* предлог *for* означает *для, за, в течение*)
if – если; ли
provided, providing (that) – при условии (что)
since – 1) так как
– 2) с тех пор как (*как* предлог *since* означает *с*)
though – хотя
unless – если ... не
until – до тех пор пока ... не
when – когда
whether – ли
while – в то время как, когда
both ... and – как ... так и; и ... и
either ... or – или ... или, либо ... либо
neither ... nor – ни ... ни
the + сравнительная степень ..., the + сравнительная степень – чем ..., тем

Приложение В

Наиболее употребительные суффиксы и приставки

Суффиксы существительных

-er, -or- – seller (продавец), constructor (конструктор)
-tion (-ation) – connection (соединение), consumption (потребление) organization (организация), indexation (индексация)
-ing – accounting (отчетность), handling (обращение)
-ment- – development (развитие), government (правительство)
(t)ure – future (будущее), expenditure (расход)
-ance (-ence) – importance (важность), dependence (зависимость)
-ness – effectiveness (эффективность), accurateness (точность)
-ity – activity (деятельность), utility (полезность)
-th – strength (сила), growth (рост)
-ship – friendship (дружба), relationship (взаимосвязь)
-ism – mechanism (механизм), materialism (материализм)
-ics – economics (экономика), physics (физика)
-ist – economist (экономист), artist (художник)

Суффиксы прилагательных

-al – national (национальный), industrial (промышленный)
-able (-ible) – changeable (изменчивый), extensible (растяжимый), convertible (обратимый)
-ant (-ent) – resistant (устойчивый), different (различный)
-ive – active (деятельный), competitive (конкурирующий)
-ful – peaceful (мирный), useful (полезный)
-ic – basic (основной), historic (исторический)
-ous – famous (знаменитый), dangerous (опасный)
-less – useless (бесполезный), careless (небрежный)

Суффиксы глаголов

-en – to weaken (ослаблять), to shorten (укорачивать(-ся))
-fy – to intensify (усиливать), to simplify (упрощать)
-ize – to realize (осуществлять), to stabilize (стабилизировать)

Суффиксы наречий

-ly – practically (практически), entirely (полностью)
-ward(s) – forward(s) (вперед), backward(s) (назад)

Приставки с отрицательным значением

un- – unlimited (неограниченный), to unfold (развертывать)
dis- – disability (неспособность), to disapprove (не одобрять)
in- – incapable (неспособный)
il- – illegal (нелегальный)
ir- – irrational (нерациональный)
im- – impossible (невозможный)
non- – non-economic (внеэкономический), non-essential (несущественный)
mis- – to miscalculate (ошибиться в расчете), to misinform (дезинформировать)
under- – to underestimate (недооценить), underdeveloped (слаборазвитый)

Приставки с разными значениями

over- *(сверх)* – to overestimate (переоценить), to overpay (переплачивать)
post- *(после)* – postwar (послевоенный), postgraduate (аспирант)
pre- *(до)* – prewar (довоенный), prehistoric (доисторический)
re- *(вновь)* – to redistribute (перераспределять), to resell (перепродавать)

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