МИНИСТЕРСТВО ОБЩЕГО И ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ

САМАРСКИЙ ГОСУДАРСТВЕННЫЙ АЭРОКОСМИЧЕСКИЙ
УНИВЕРСИТЕТ

ОБУЧЕНИЕ ЧТЕНИЮ ЛИТЕРАТУРЫ ПО СПЕЦИАЛЬНОСТИ «ЛЕТАТЕЛЬНЫЕ АППАРАТЫ»

(английский язык)

САМАРА 2002

Составители: Архипова Т.В.,
Ермишина С.М.,
Поваляева Н.П.,
Степнова Н.Г.
ОБУЧЕНИЕ ЧТЕНИЮ ЛИТЕРАТУРЫ ПО СПЕЦИАЛЬНОСТИ «ЛЕТАТЕЛЬНЫЕ АППАРАТЫ»: Учебные задания по англ.яз./Самар.гос.аэрокосм.ун-т; Сост. Т.В.Архипова, С.М.Ермишина, Н.П.Поваляева, Н.Г.Степнова. Самара, 2001.

Настоящее пособие предназначено для студентов II курса аэрокосмического университета и направлено на развитие умений и навыков чтения и перевода текстов авиационной тематики.

При составлении пособия авторы ставили целью повторение и обобщение основных грамматических тем и лексики. Тематика текстов определяется будущей профессией студентов.

Тексты взяты из английских и американских источников и адаптации не подвергались, были только сокращены.

Печатаются по решению редакционно-издательского совета Самарского государственного аэрокосмического университета имени академика С.П.Королева

Рецензент Л.И.Карлинская

Unit 1
Text A

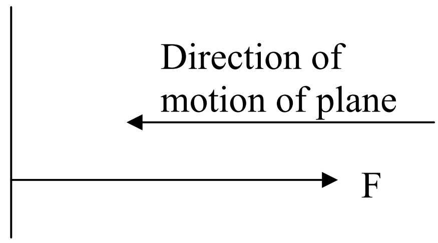
I. Active Vocabulary.

1. to experience – испытать; 2. to exert – вызывать, оказывать влияние; 3. to suppose – предполагать; 4. to resolve – распадаться, разлагаться; 5. magnitude – величина; 6. precisely – точно; 7. concerning – относительно; 8. to maintain – поддерживать, сохранять; 9. to overcome – преодолевать; 10. ratio – отношение; e.g. aspect ratio – отношение размаха к средней величине хорды; 11. coross-sectional view – вид поперечного сечения; 12. flying level – горизонтальный полет; 13. to climb – набирать высоту; 14. to descend – снижаться

AIRCRAFT AND SOME FACTS ABOUT THE FLIGHT

FORCES ACTING ON THE AIRPLANE IN FLIGHT

Here we are going to give you an elementary idea of aerodynamics. Moving through the air, any solid body experiences a reaction. The air flowing around the body exerts a force on the subject. The higher the speed of the body, the greater the reaction is.

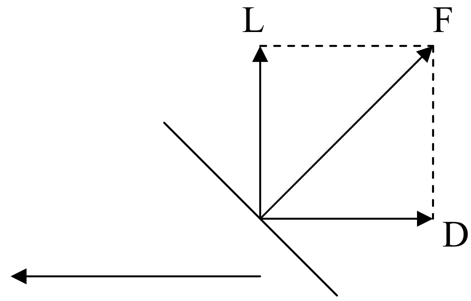


Consider, for example, a thin flat plate. Suppose that the plate is moving horizontally through the air. While moving in the air, the plate meets the air at right angles to it. The reaction F on the moving plate is resistance acting in the opposite direction to that of the motion of the plate.

Next, imagine that the plate is no longer perpendicular to the direction of travel. The plate having an angle to it, the reaction no longer acts along the line of movement. It is at an angle to the direction of travel.

The force of the air F pushes the plate at an angle to the airflow upwards and backwards.

It is convenient to resolve the total force F acting on the plate into two forces L and D at right angles to each other, L acting vertically upward and D – horizontally and opposite to the direction of movement. The magnitudes of L and D are such that their combined effect on the flat plate is precisely the same as that of the single force F. These are the two most important forces one must know concerning an aircraft.



Direction of motion of plane

The aircraft is able to rise into the air and to keep in the air because of the forces working on it, the motion itself maintaining them.

When moving in the air, the aircraft produces an upward force L which we call the lift, the lift being that portion of the force which acts at right angles to the direction of the air stream.

The lift overcoming the weight of the machine, the airplane rises from the ground. At the same time there appears the drag resisting the movement of the airplane. One of the chief problems confronting the airplane designer is how to keep the drag as low as possible. A good lift/drag ratio is one of the most important qualities an airplane must have to lift the maximum possible load with the minimum power. The thrust the engine develops must overcome the drag. The thrust pushes the plane forward, overcoming the resistance of the air against the plane. The thrust being greater than drag, the aircraft speed will steadily increase.

The lifting power and the drag of a wing depending on the angle of attack, the shape and size of the wing, the density of the air and the speed of flight, the designer has to consider them.

I. Answer the questions:

1. What does the air exert on the subject?
2. When the reaction is greater?
3. In which direction the resistance is acting?
4. Is it convenient to resolve the total force F?
5. What are the magnitudes L and D?
6. What is their combined effect?
7. What does the motion itself maintain?
8. How does the lift act as a portion of resultant?
9. What is the most important quality of an airplane?
10. When the aircraft speed steadily increase?
11. What notions has the designer to consider?

II. Read the text. Pay attention to the definition of Daniel Bernoulli's Law.

Text B

HOW DOES A PLANE GET ITS LIFT?

The mathematician Daniel Bernoulli gave us the answer about the middle of the eighteenth century. He found that the faster a liquid or gas moves the less pressure it exerts.

Let us take a look at the cross-sectional view of the airplane wing. As the wing travels forward its front edge parts the air which flows over and under the wing, joining up again at the rear edge.

Notice the shape of the wing. The distance which the air flowing over the top of the wing must travel is greater than the distance which the air travels while flowing along the bottom of the wing. Hence if these two portions of air are to join up, the air flowing over the top of the wing must travel faster than the air flowing along the bottom of the wing. Now Bernoulli said that the faster a gas flows, the less pressure it exerts. Thus, the pressure of the faster-flowing air on the top of the wing is less than that of the slower-moving air at the bottom. The pressure under the wing being greater, the wing goes up. In this way the airplane gets its lift. The lift on an airplane acts vertically upwards and its weight – vertically downwards. Therefore when an airplane is flying level, its lift is just equal to its weight. The lift being greater than the weight, the airplane will climb; the lift being less, the airplane will descend.

Notes to the text

The area of the pressure of the slower – moving air is called sucktion.

III. Try to make a drawing of the airfoil. Retell how the plane gets its lift.

I. Pay attention to the words and expressions:
   1. estimate – оценка
   2. with respect to – по отношению к …
   3. there would be no point – не сто́ит …
   4. entire - весь

Text C
THE CENTER OF GRAVITY OF AN AIRPLANE

Before the airplane is built, the designer will determine its probable center of gravity. A carefully detailed estimate is made of the weight of each of the parts on an airplane, and the center of gravity is calculated.

If the center of gravity is not properly located with respect to the wing, the design of the airplane must be modified. There would be absolutely no point to building an airplane whose center of gravity, for example, fell behind the wings. It would never fly. The purpose of this job is to show how the center of gravity of an airplane is determined.

BEFORE THE AIRPLANE IS BUILT

The task of finding the center of gravity of the complete airplane before it has yet been built is simplified by working with the larger units of which the airplane is to be constructed, such as the aircraft engine, the wings, the landing gear, the fuselage, and the tail surfaces.

1. *The weight of each* of these units is carefully estimated.
2. The *center of gravity of each* of these separate units is determined or estimated.
3. The *center of gravity of the entire airplane* can now be found, using the method of moments.

AXES AND STABILITY OF AN AIRPLANE

The first time they try to fly an airplane, students are always surprised to find that the airplane flies better when they take their hands off than when they try to "control" the airplane. They learn to their surprise that the airplane does not fall away in a dizzy spin when the controls are entirely free but continues to fly as calmly and peacefully as ever and much more smoothly.

This is because of the airplane's inherent stability.

Types of Stability

There are three types of stability.

An object that possesses *positive stability*, if slightly distributed, will return to its original position.

An object that possesses *negative stability*, if slightly distributed, will fall over to some new position. Such an object is unstable.

An object that possesses *neutral stability*, if moved from its original position, will simply remain balanced in its new position, as, for example, the sphere.

Positive stability can now be defined as a condition of a body in which, if it is distributed, moments are set up that tend to restore the body to its original state of equilibrium.

Airplanes are safe to fly because they have positive stability. If an airplane is thrown out of balance, moments are immediately set up that tend to restore the airplane to a state of equilibrium.

Text D (for written translation)

I. Active Vocabulary:

1. axes – оси
2. longitudinal – продольная
3. lateral – поперечная
4. to possess – обладать
5. rolling – кренение
6. banking – крен, «бочка»
7. pitching – тангаж
8. yawing – рысканье
9. inherent – присущий
10. wildly – хаотично, беспорядочно

Three Axes of an Airplane

The airplane has three axes, which are like gigantic imaginary pins passing through the center of gravity.

The longitudinal axis passes from the nose to the tail of the airplane.

An airplane possesses all the freedom of a body in space. The wings can rotate around the longitudinal axis. This motion is called rolling. The pilot can move the ailerons, so as to cause either wing tip to move up or down (banking) or to correct undesirable rolling.

The nose and tail surfaces of the airplane can move up or down around lateral axis.

This motion is called pitching. The pilot can use the elevators to raise or lower the nose of the airplane. The nose and tail can also swing from side to side around the vertical axis. This motion is called yawing. By using the rudder, the pilot can cause the airplane to yaw to either side.

Rolling, pitching and yawing may take place as individual motions, but it is more common for any airplane maneuver to be a combination of two or three of these motions.

As we have said before, the airplane possesses inherent positive stability. It doesn't pitch, roll, and yaw wildly. If it did, the pilot would soon exhaust him self constantly correcting erratic motion. On the contrary, should a slight motion such as rolling take place because of an accidental gust of wind, moments are created that cause the airplane to return to its original position.

Notes to the text D (2)

1. to remain – оставаться
2. to get acquainted – познакомиться
3. aloft – в полете
4. entirely – полностью
5. a kite – воздушный змей
6. to strike - ударять

BASIC PRINCIPLES

Whether the wing is of the rotating type (as in the helicopter) or of a fixed type commonly used today, certain basic principles remain the same.

1) There must be a source of lift (such as the airplane wing) to carry the weight of the plane. Without this "lift" there can be no flight.
2) There must also be a source of power (such as the aircraft engine) which provides the thrust to move the plane against the drag caused by the resistance of the atmosphere.

Lift against weight, thrust against drag are the four forces always acting on an airplane in flight.

Lift and drag, thrust and weight are the pilot's friends – or the pilot's enemies.

The pilot would do well to get acquainted with these forces – they will be his constant companions in flight.

THE LIFT OF AN AIRPLANE

Without lift there could be no airplane as we know it today, because the plane could never remain aloft in the air. It could never even get off the ground.

The lift of the airplane is developed almost entirely by the airplane wing. Studies of the airplane wing have shown certain surprising results. It might at first glance seem probable that the airplane is lifted by the force of the wind against the *lower* surface of the wings, much in the same way that the wind carries a kite, but this is not true.

Actually, only about one-fourth of the total lift is created by the action of the air stream striking at an angle against the lower surface. Full three-fourths of the total lift is developed on the *upper* surface of the airplane wing.

Definition: *Lift* is the force that tends to move the airplane wing in a direction perpendicular to the air stream. Lift is caused by the low-pressure region above the wing and in larger airplanes is great enough to carry many tons of weight.

In this chapter, the specific factors upon which the lift of an airplane wing depends will be presented.

Lift Depends on the Area of the Wing

A moment's thought will show how natural this is. Large transport planes have tremendous wings because they must "lift" great weights, while moving through the air. On the other hand, light training planes have small wing areas, because they are supposed to carry only one or two passengers and small amounts of fuel, oil, etc.

Unit 2
Aerofoils

I. Active vocabulary:

1. Aerofoils – аэродинамическая плоскость, профиль крыла; 2. substantial – существенный, мощный; 3. surrounding – окружающий; 4. to sustain – поддерживать; 5. behaviour – поведение, действие; 6. angle of incidence – угол установки; 7. smoothly – плавно; 8. turbulence – возмущение; 9. laminar – ровный; 10. streamlining – обтекаемость; 11. stall – срыв потока; 12. eliminate - устранять; 13. trail - след; 14. vortex - завихрение; 15. violent – неистовый.

Apart from the fuselage and the engines, the most important parts of an aircraft are the surfaces known as aerofoils. These include the rudder, elevators and ailerons, whose function is to control the aircraft in flight; and the wings which provide the lift necessary to overcome the weight of the aircraft and lift it through the air. A substantial horizontal thrust, provided by the jet or the propeller, drives the aircraft through the surrounding air, while the wing deflects downwards the mass of air *flowing* on to it. This produces a reactive force *acting* in the opposite direction, which lifts the wing upwards. Without some means of horizontal propulsion, no lift can be produced by the wing. Modern aircraft are **so heavy that** the wings must develop a very large lift force in order to sustain the aircraft.

The design of the wings is therefore very important, and various factors have to be considered. Wind-tunnels *reproducing* flight conditions are used to examine the behaviour of the *flowing* over different types of wings at different speeds. The lift produced by a wing will depend on, among other factors, the wing area, its profile, and the angle of incidence – that is, the angle at which the wing is inclined to the direction of motion. Air *flowing* over the top of the aerofoil should flow smoothly and without turbulence. This laminar flow is achieved by streamlining the profile and by making the skin of the aerofoil smooth. As a result, the air-flow will follow the contour of the wing, except for a narrow boundary layer of stationary air on its surface. However, above a certain angle of incidence, which varies with the type of wing, the air-flow is liable to break up and become **so turbulent as to** destroy the low-pressure region above the wing. This causes **such a rapid loss of lift that** the aircraft may stall. To counteract this, slots are sometimes fitted to the leading edge of the wing, *guiding* the air-flow more steadily over the aerofoil. Since low speeds are essential for landing, extendable flaps are also fitted to the trailing edge. These extend the effective area of the wing, and thus prevent the aircraft from stalling.

The force exerted by the deflected column of air beneath the wing has a vertical component called lift, and a horizontal component called drag. Drag in its various forms represents a loss of the energy available to provide lift, but it always accompanies lift. It can never entirely eliminated, since the wing itself offers resistance to the air through which it moves. A laminar flow over the wing, *reducing* drag to a minimum, is the optimum condition. But around the wing-tips and on the trailing edge, some turbulence is inevitable. The air, *flowing* through a region of higher pressure under the wing, swirls up at these edges into a region of low pressure above the wing and produces a vortex, which may be **so violent as to** produce vapour trails at the wing-tips.

WORK STUDY

Effective

a) = having the desired effect

1. Heavy water is more *effective* in slowing down neutrons than graphite.
2. Compounding is more *effective* when high compression ratios are involved.
3. Ring hydrocarbons are *effective* in reducing the tendency of a fuel to detonation.

b) = real or actual

The *effective* working time is only six hours, because work stops for an hour at lunch.

The *effective* power of an engine can be measured by a dynamometer.

The *effective* pressure is reduced by the back pressure in the cylinder.

Factor

1. In choosing an engine, one *factor* to be considered is ease of transportation.

2. In the development of high speed engines, a limiting *factor* is the rate at which fuel can be burnt.
3. Thermal efficiency depends on a number of *factors*, including nozzle efficiency.
4. In converting lb/in^2 to lb/ft^2, the *factor* 144 must be introduced into the calculations.

Thrust

1. A thrust bearing takes the longitudinal down the axis of a shaft
2. The pillars of a building take the from the arches.
3. The engines provide the forward *thrust* that drives the aircraft through the air.
4. This engine develops 100,000 lb of

Laminar, Laminated, Agitated, Turbulent

1. The air-flow over the aerofoil becomes *agitated* at low speeds.
2. The designer aims to prevent *turbulent* steam flow through the turbine nozzle.
3. Combustion in a cylinder is assisted by *turbulence* in the mixture.
4. The design of the aerofoil encourages a *laminar* airflow over it.
5. Below a certain velocity, the liquid will have *smooth* flow through the pipe.
6. Thin layers of wood are stuck together to form *laminated* wood.
7. The plastic material is made of thin layers bonded together to form *laminated* plastic.
8. The direct current armature core is *laminated.*

PATTERNS

1. Result (2)

Here is another common structure for expressing Result.

1. The increase in population is *so rapid that* there is a food shortage.
2. The population is increasing *so rapidly that* there is a food shortage.
3. The country has *so many* natural resources *that* it can support itself easily.
4. The country has *so much coal that* it can export large quantities.
5. The problem is *so complex that* it can only be solved by computers.
6. The increase in population is *so rapid as to* cause a food shortage.
7. The population is increasing *so rapidly as to* cause a food shortage
8. There is *such* a rapid increase in population *as to* cause a food shortage.
9. There are *such* rapid increases in population *as to* cause a food shortage.
10. The country has *so little* coal *as to* make it necessary to import large quantities.

2. The Active Relative (-ing)

Look at these sentences:

The man *who operates the lathe* is a skilled worker.
The spark *which passes between the electrodes* ignites the fuel.
Wind-tunnels *which reproduce flight-conditions* are used.

Each of these statements contains a relative clause which is active in form.
When it is in the Present tense (and rarely in the Past tense) a shortened form is used:
The man *operating the lathe* is a skilled worker.
The spark *passing between the electrodes* ignites the fuel.
Wind-tunnels *reproducing flight-conditions* are used.

3. Exceptions

It is important not to confuse the following three items:

1. *a.* Everyone in the room comes from Egypt,		the teacher. (=he does not)
b. None of the planets is inhabited,	*except* (for)	the earth.
c. All solids expand when they liquefy,		ice and a few others.

	the teacher, everyone in the room comes from Egypt.
Except for	the earth, none of the planets is inhabited.
With the exception of	ice and a few others, all solids expand when they liquefy.

2. *a.* An engine cannot run		fuel. (=in the absence of fuel)
b. Toughened steel machines easily run	*without*	tearing.
c. The engine would quickly overheat		an efficient cooling system.
d. Gases cannot be quickly compressed		generating heat.

3. *Apart from*	the lecturer, there are twenty people here. (=not counting him)
Besides	coal, the most important natural fuels are gas and oil.
In addition to	its lightness, aluminium has several other advantages.
	the earth, how many planets revolve around the sun?

Text B
TYPES OF AIRPLANE WING

Area is a factor of great importance in determining the lift of an airplane wing. The wing area, however, may be arranged in many different ways. For example, the aircraft designer may choose to spead the required area over one large wing, thus building a monoplane. On the other hand, he may divide the required area into two wings, as in a biplane, or even into three or more wings.

A glance at the top view of any group of airplane will show that many different wing forms have been developed. Each of these wing forms has its purpose, the creation of sufficient lift to carry the weight of the airplane for which it is designed. However, each of these forms is a compromise between ease of construction in the factory and good performance in the air.

Calculating Wing Area

Aircraft specifications, in giving the size of airplane wings, use two technical terms, the span and the chord.

Definitions: *Span* is the length of the wing from wing tip to wing tip. *Chord* is the width of the wing from leading edge to trailing edge.

There is a special formula used in aerodynamics for the area of a wing.

Formula: $A = sc$

in which A = wing area (including ailerons)
s = span
c = chord

LIFT DEPENDS ON THE SPEED OF THE PLANE

People sometimes say of a reckless automobile driver, "He was going so fast he almost took off". This remark reflects the fact that for the airplane speed creates lift. Speed creates lift – and it makes no difference whether the wind speeds over the stationary wing or the wing speeds through the "stationary" air. In the wind tunnel the model is fixed and the air moves. Yet the results can be used for an airplane moving through the atmosphere.

A model airplane mounted in a wind tunnel was measured for lift under various conditions of speed.

Text C
TYPES OF SPEED

The airplane starts slowly down the runway, gathers speed, travels faster and faster till, under the pilot's expert control, it leaves the ground and flies through the atmosphere. From take-off to landing the airplane has been traveling at different speeds. Words such as "landing speed", "cruising speed", and "top speed" are part of every pilot's vocabulary. They are given in all airplane specifications. Do you know what they mean?

Definitions:

Top speed is the greatest speed at which the airplane can travel in level flight through still air. This is sometimes called the "high speed". Here the airplane engine is exerting its maximum power. There is practically nothing the pilot can do to increase the top speed of an airplane.

Cruising speed is the speed of the airplane when the aircraft engine is operating at about 75 per cent of its full power.

The aircraft engine would wear out very quickly if it were operated continuously at peak load. It is therefore wiser to operate the aircraft engine at considerably less than peak load. This naturally results in a decrease of power and a loss of thrust. As a result, the cruising speed of an airplane is always less than its top speed.

Landing speed is the slowest speed at which the airplane can fly and still be under control.

Aircraft designers naturally want low landing speeds for the sake of safety. They also strive to obtain high cruising speeds and high top speeds, especially for military aircraft.

The air-speed indicator is one of the pilot's most useful instruments. It tells him how fast the airplane is moving through the air. Notice that the air-speed indicator is calibrated in miles per hour.

The definitions given in this job all refer to the air speed of the airplane. In our study of air navigation, we shall see that speed with relation to the ground (ground speed) is not the same as the air speed. Can you guess why?

LIFT DEPENDS ON THE SHAPE OF THE AIRFOIL

The Airfoil Section

If an airplane wing were sawed completely through a certain outline would result.

This outline is called an *airfoil section.*

Definition:

Airfoil section is the outline of the cross section of an airplane wing.

The airfoil section determines the shape of the ribs that are used in the construction of the airplane wing. The airfoil section also determines the nature of the flow of air over the wing when the airplane is moving through the atmosphere. As a result, the shape of the airfoil section is one of the important factors on which the lift of the airplane depends.

Definition:

1. *Chord line* is a straight line usually connecting the leading edge and trailing edge of the airfoil.
2. *Upper camber* is the curved upper part of the airfoil section from leading edge to trailing edge.
3. *Lower camber* is the lower part of the airfoil section from leading edge to trailing edge.

The front of the airfoil section will become part of the leading edge of the airplane wing, while the end of the section will become part of the trailing edge. This distance between the leading and trailing edge of an airfoil section is called the *chord* of the *wing.*

The Angle of Attack

When an airplane is flying, the chord line of the wing is not always parallel to the air stream.

More frequently, the chord line makes a definite angle with the air stream.

Definition:

Angle of attack is the angle between the chord line of an airfoil and the relative wind.

Text D

LIFT DEPENDS ON THE DENSITY OF THE ATMOSPHERE

The earth is a sphere surrounded by an ocean of air. The air is heaviest at the floor of this air ocean, that is, at the surface of the earth. As the pilot climbs higher, he finds that the air gets thinner. It becomes more difficult to breathe, the engine loses power, the wings lose lift.

We are not accustomed to thinking of the air as having weight, but it can actually be shown that a cubic foot of air has a definite weight.

The weight of one cubic foot of air at sea level under standard conditions (16ºC or 59ºF.) is about .08 lb.

The weight of a cubic foot of air at 30,000 ft. is only about .03 lb., or less than half the weight of the same volume of air at sea level. This means that a plane at 30,000 ft. can lift only half as much as a plane at sea level.

Absolute ceiling of an airplane is the highest altitude that the airplane can reach under normal conditions. At its absolute ceiling, an airplane is not very maneuverable; any attempt to make the airplane climb will probably result in a stall. The word “ceiling” is also used in aviation in several other important ways:

Service ceiling is the altitude at which an airplane can still climb at a rate of 100 ft. per min. This means that the airplane is still maneuverable, that is, the pilot can still travel in any direction he chooses.

WING DRAG AND PARASITE DRAG

Did you ever try to push a nail through wood? The wood offers so much resistance to any object passing through it that we must use a hammer to create a force great enough to push the nail.

Did you ever try to push a drill through steel? The steel offers even greater resistance than the wood to oppose the motion of an object trying to move through it.

On the other hand, if you have tried to push a small log through the water, you know that water also offers considerable resistance to object moving through it, but certainly not so much as wood or steel. Just imagine pushing a small log through wood or steel.

The air also offers resistance to the forward passage of a body through it. Try to push a large piece of cardboard, such as a sign, against the wind, if you doubt this. Even air that is absolutely still create resistance to objects trying to pass through it.

The resistance of the air to objects that move through it is called the *drag*.

The wind tunnel has done more than any other single device to help us understand the airplane.

Sensitive instruments placed inside of a specially constructed wing in a wind tunnel have shown that forces are developed all over the entire surface of the airfoil as it moves through the atmosphere.

Furthermore, all these forces can be made to add up to one force, called the *resultant force*.

It is the resultant that creates both the lift and the drag of the wing.

Unit 3

Active vocabulary:

1. capacity payload – грузоподъемность
2. statute mile – стандартная миля (1600, 3 м)
3. head-winds – встречные ветры
4. stand-off – ожидание в зоне аэродрома
5. bag type fuel tank – мягкий бак
6. stub-wing – полукрыло
7. spar webs – края лонжерона
8. cantilever – консольный, свободнонесущий
9. bogie – тележка

Read and translate

Text A
THE D.H. 106 COMET

Brief details of the Civil version of the Comet 4.

The Comet 4 will carry 60 passengers (capacity payload of 16,720 lb. = 7,598 kg.) over a stage length of 3,000 statute miles (4,828 km), allowing for reserves for climb, descent, head-winds, standoff and diversions. Alternatively, it will carry 76 tourist class passengers (capacity payload of 19,361 lb. = 8,782 kg) over a stage length of 2,700 statute miles (4,345 km) with reserves.

Type. – Four-engined Jet Airliner.

Wings. – Low-wing cantilever monoplane with moderate sweepback, with two jet engines accommodated in each stub-wing, passing through the front and rear spar webs. Integral and bag-type fuel tanks and thermal de-icing. Air-brakes are fitted. Plain flaps outboard of the engine and split flaps inboard, with hydraulic operation. Extensive use of metal-to-metal bonding. Chord 29 ft.6in. (9.0 m.) at root, 6 ft.9in. (2.06 m.) at tip. Gross wing area 2.121 sq. ft. (197 m^2).

Fuselage. – Of circular cross-section, 10 ft. (3.05 m) in diameter throughout length of cabin. A pressure dome seals the aft end of the cabin.

Tail Unit. – Cantilever monoplane tailplane and single fin and rudder. Tailplane span 47 ft. 5 in. (14.45 m).

Landing Gear. – Retractable tricycle type. Each main unit carries a four-wheel bogie retracting outwards into wings. Doors retract when undercarriage is down. Twin-wheel nose unit is steerable and retracts backwards into fuselage. Hydraulic retraction. Wheel track (shock-strut centres) 28 ft.2in. (8.58 m). Wheel base (shock-strut centres) 46 ft.8in. (14.22 m).

Power Plants. – Four RA. 29 turbojet engines (10,500 lb. = 4,767 kg.s.t. each). Hinged panels below wings expose whole installations for easy servicing from ground. Quickly-detachable air intake and tail pipe connections and special disconnect-joints in engine control connecting rods. Installation is split into three temperature zones, each zone being separated by fireproof bulkhead and having its own ventilators and fire-extinguishing system. Fuel in integral and flexible bag-type wing tanks, flexible bag tanks in centre-section and projecting leading-edge tanks with pressure refuelling. Fuel capacity, 8,869 Imp.gallons (40,277 litres).

Accommodation. – Flight deck forward, with accommodation for two pilots with full dual control, flight engineer, and radio-operator/navigator. Seating capacity 60/70 passengers. Flight deck, cabin and freight compartments pressurised to $8^3/4$ lb./sq. in. (0.6 kg/cm^2) by air tapped from the engine compressors, giving a cabin altitude of 8,000 ft. (2.436 m) when the aircraft is at 40,000 ft. (12,120 m). Cabin 55 ft.10in.long, max.9 ft. 9 in. wide and max. 6 ft 6 in.high (17.01x2.96x1.98 m). Galley, toilet, wardrobe and dressing amenities. Main passenger door in port side at end of cabin, and crew door forward in starboard side; both open inwards and measure 4 ft. 8in. x 2 ft.6 in. (1.43 m. x 0.761 m.). Freight capacities: rear hold floor 155 cub.ft. (4.387 m^3); rear hold (under floor) 240 cub.ft. (6.792 m^3).

Dimensions. – Span 107 ft. $9^1/2$ in. (32.86 m).
Length 118 ft. (35.97 m.)
Height 28 ft. 5 in. (8.66 m.).

Weights. – Basic operational weight 72,595 lb. (32,930 kg).
Capacity payload (60 seats) 16,720 lb. (7,598 kg).
Capacity payload (76 seats) 19,361 lb. (8,782 kg).
Weight loaded 152,500 lb. (69,235 kg).
Max.landing weight 113,000 lb. (51,260 kg).

Performance. – Cruising speed 500 m.p.h. (800 km/h).
Take-off field length at max.A.U.W. 6,380 ft. (1,945 m).
Landing distance from 50 ft. (15.25 m) 3,520 ft. (1,073 m).

Max.still air range with 9,155 lb. (4,152 kg) payload at 472 m.p.h. (760 km/h) at 38,850 ft. (11,840 m) no reserves, 4,671 miles (7,517 km).
Range, still air, with max.payload, no reserves, 3,774 miles (6,074 km).

Answer the questions:
1. What is the type of the Comet 4 aircraft?
2. Is the Comet 4 a civil or military as version?
3. What parameters of wings are given?
4. What is the place of retraction of the main landing unit?
5. Where does twin-wheel nose unit retract into? What kind of retraction is it?
6. What are power installations exposed for?
7. Are three any tanks with pressure refuelling? Where are they situated?
8. Who operates this aircraft?
9. What facilities are there for passengers?
10. Give performance of the Comet 4.

Read the text B.

LOCKHEED'S l-500 WEIGHTLIFTER
Aircraft Description

The L-500 is an all cargo aircraft powered by four high-bypass turbofan engines[1] in the 50,000 lb thrust range. The three-quarter length duct nacelles[2] are equipped with fan thrust reversers[3] and two of these are usable while airborne, as well as on the ground. The main cargo compartment cross section is 19 feet wide and 13.5 feet high. A visor door[4] provides a clear opening at the forward end for cargo loading and unloading. As seen in the profile view, the compartment extends in the upper lobe[5] forward and aft of the wing box[6]. A cargo loading door is provided for each section of the upper compartment and a bulk loading door is located aft in the lower cargo compartment.

The maximum payload is 320,000 lb over a range of approximately 2,600 nautical miles.

Accommodation for a flight crew of three and an observer is provided in the L-500 flight station which is situated in the forward upper fuselage. A three-sent courier compartment is located aft of the crew station along with a closet, galley and lavatory. A hatch provides access to the lower main cargo compartment and a crew entry door is situated on the starboard side of the aircraft.

The main landing gear comprises four separate struts, each mounting four wheels. Two strut assemblies, and bogies, are mounted in tandem on each side of the fuselage. The nose gear strut mounts four wheels on a common axle. Gear design and wheel locations are such that flotation[7] of the Lockheed L-500 is comparable to present-day jet transports and entirely compatible with existing commercial airport runways.

Twelve integral fuel tanks, located in the wing have a total fuel capacity of 318,500 lb. The arrangement of the tanks and the on-board fuel management system maintains the aircraft C of G within limits. Rapid refuelling can be accomplished at a rate of 2,400 US gallons/min by the simultaneous use of four ground servicing units located in the main landing gear fairing.

The structure of the L-500 is engineered for a design lift of 100,000 hours and 40,000 landings, while requiring a minimum of maintenance. The proposed L-500 programme, should the company decide to go ahead with the project, envisages the use of a structurally complete airframe for both static and fatigue testing.

Proposed Federal Aviation Agency noise requirements have been given a great deal of attention in the design of the L-500. The present nacelle design has acoustical lining in both inlet and fan exhaust ducts[8]. Other means of reducing noise being investigated include the design of longer ducts, use of additional sound absorbing material, more efficient materials, etc.

Notes to the text

1. high-bypass turbofan engine – двухконтурный турбовентиляторный двигатель
2. three-quarter length duct nacelles – гондолы, в которых выхлопные трубы ступени вентилятора составляют 3.4 длины
3. fan thrust reversers – механизмы управления реверсом тяги вентилятора
4. visor door – люк с козырьком
5. in the upper lobe – в верхней части (секции)
6. wing box – коробка крыльев
7. flotation – зд. устойчивость
8. fan exhaust duct – выхлопная труба ступени вентилятора

I. Translate the following word combinations from the text:
the main cargo compartment, a cargo loading door, a bulk loading door, the forward upper fuselage, a crew entry door, the starboard side of the aircraft, the main landing gear, the nose gear strut, commercial airport runways, integral fuel tanks, a total fuel capacity, the on-board fuel management system, ground servicing units, landing gear fairing, sound absorbing material.

II. Find numerical information about:
a) thrust range of L-500.
b) Cross section of the main cargo compartment.
c) Maximum payload of L-500.
d) A range of L-500.
e) Total fuel capacity.

III. Translate Passive Voice constructions.
is powered, are equipped, is provided, is located, is situated, are mounted, can be accomplished, is engineered, have been given.

IV. Give oral description of the text Lockheed's L-500 Weight Liffer.

Text C.

THE MIRAGE F1 INTERCEPTOR AND GROUND ATTACK AIRCRAFT

The Mirage F1 is a single seater with swept wing and classic tail design. The high wing, of thin section and negative dihedral, is fitted with moveable slots along the whole of the leading edge, as well as flaps which cover two thirds of the trailing edge. The one piece tail-plane is placed lower on the fuselage than the wing. The two wheel main undercarriage units retract into the fuselage. The engine is an Atar 9K 50 developing about 15,873 lbs thrust with afterburning. The wing leading edge is highly swept, but the trailing edge is, by comparison, almost straight in view of the use of large double slotted flaps. The need for high lift capacity has necessitated a greater aspect ratio than that of the Mirage 3 and low altitude high speed characteristics are good, in view of the increased wing loading. This type of wing, with its high lift devices[1], has resulted in a lift coefficient in the landing configuration more than doubly superior to the Mirage 3. It has resulted in a marked reduction in approach speed, which in itself produces two big advantages: the chance to carry out landings without undue risk in bad visibility; an important simplification in the conversion training of young pilots, for whom the approach procedures in an operational aircraft capable of Mach 2,2 are as simple as those carried out in a training school aircraft. The handling characteristics have also been improved throughout the whole flying range.

Two types of air frame improvements have been incorporated one concerning the fuselage structure and the other the landing gear. As regards the basic structure, the main improvement has been the incorporation of integral fuel tanks[2] in the fuselage. The main structural units consist of large machined elements with multiple functions: this eliminates almost completely the need for thin sheet overlapping and secondary joint riveting. The fuselage tanks, whose plan surfaces are relatively small, are in effect protected below against small calibre projectiles by (from front to rear) the nose wheel, guns, main wheels and engine.

The undercarriage has been so designed that the wheels retract laterally into the side of the aircraft freeing the wing roots and wings for the fitting of external loads. Although the undercarriage retracts into the fuselage, the main undercarriage track is as wide as that of the Mirage 3. The first production machines in the Mirage F1 series will be powered by the SNECMA Atar 9K 50 engine, a slightly modified version of the Atar 9K, which is fitted to the Mirage 4 bomber. This engine, with a lower fuel consumption and extended operational life compared to its immediate predecessor, has about 50% of parts in common with the Atar 9C engine of the Mirage 3. A later version of the F1 will be fitted with a Super Atar, a more powerful engine which enhances performance in supersonic flight, radius of action and weapons load; and whose installation needs no modification to the Atar 9K 50 engine bay.

Notes to the text

1. high lift devices – высокая механизация
2. integral fuel tanks – кессон-баки

Unit 5

I. Active vocabulary

root – корневая часть
aspect ratio – относительное удлинение
to rivet – приклепывать, прикреплять
spar – лонжерон
rib – нервюра, ребро
trim tab – триммер
flap – закрылок
stressed – усиленный
elevator – руль высоты
rudder – руль поворота
to cover – покрывать
landing gear – шасси
retractable – убирающийся
shock absorber – амортизатор
leg – стойка
cockpit – кабина пилота

II. Translate the following sentences.

1. The airplane has a delta wing with high lift devices.
2. The Comet is a long wing cantilever monoplane.
3. The wing has plain flaps and split flaps with hydraulic operation.
4. The tail unit of the Comet consists of a single fin and rudder.
5. The ribs give the wing a special streamlined shape.
6. Multi-spar wings have no stringers, and often no ribs.
7. Spars form the structural foundation of the wing.

III. Insert words from the vocabulary.

1. The Dove is a cantilever … monoplane.

2. The wing has all-metal structure with stressed aluminium-alloy … .
3. … is of the cantilever monoplane type.
4. … are interchangeable left and right.
5. There are controllable metal … in rudder and elevators.
6. … seating a pilot and co-pilot has dual controls.
7. There is a forward … under floor of cockpit.

IV. Translate the following word phrases.
root chord; aspect ratio; stressed aluminium-alloy skin; riveted to spars and ribs; oval-section monocoque structure; metal-covered fixed surfaces; fabric-covered elevators and rudder; adjustable for incidence on ground; controllable metal trim-tabs; shock-absorber legs; sound-proofed main cabin; luggage compartment.

V. Give Russian equivalents of the following international words.
transport; role; chord; metal; aileron; pneumatical; section; fuselage; oval; type; pilot; control.

VI. Read & translate the text A.

The D.H 104 Dove

The Dove is a light transport airplane. It is now operating in a variety of roles all over the world. It is a cantilever low-wing monoplane. Root chord is 8 feet 8 inches and aspect ratio is 9 feet. The wing has all-metal structure with stressed aluminium-alloy skin riveted to spars and ribs. Is has mass-balanced aluminium-alloy ailerons. There are trim-tabs in each, adjustable on ground only. Besides there are pneumatically operated plain-hinge flaps in two section of each side. The fuselage has an oval-section monocoque structure with stressed aluminium-alloy skin. The tail unit is of the cantilever monoplane type. It is a light-alloy structure with metal-covered fixed surfaces and fabric-covered elevators and rudder. The tailplane is adjustable for incidence on ground. The elevators are interchangeable left and right. There are controllable metal trim-tabs in rudder and elevators. The landing gear is retractable and tricycle. The shock-absorber legs are interchangeable left and right.

The cockpit seating a pilot and co-pilot has dual controls. Main cabin, ventilated and sound-proofed, has accommodation for eight passengers. There is a forward luggage compartment under floor of cockpit with volume of 22 cubic feet. Besides there is an aft luggage compartment with volume of 45 cubic feet.

VII. Find aviation terms in the text and translate them.

VIII. Find sentences in the text about description of:
1) самолета
2) крыла

3) элеронов
4) триммеров
5) закрылков
6) фюзеляжа
7) хвостового оперения
8) сплавов
9) багажных отсеков
10) шасси
11) рулей высоты

IX. Answer the questions.

1. What is the Dove?
2. What wing has the Dove?
3. What fuselage has the Dove?
4. What tail unit has the Dove?
5. What is interchangeable left and right?
6. What is controllable?
7. What can you say about the cockpit of the Dove?
8. Is there a luggage compartment?

X. Retell the text.

Read and translate the text B.

THE BREGUET 1150 ATLANTIC

Description

The Breguet 1150 Atlantic is a mid-wing monoplane of high aspect ration powered by twin Rolls-Royce Tyne Rty.20 Mk.21 turbo-prop engines, each developing 6,105 ehp, driving four-bladed Hawker Siddeley propellers of 16 ft. diameter. The "double-bubble" configuration fuselage[1] has a boom extension beyond the tailplane to carry a MAD system. The upper section of the fuselage, which houses the flight deck, operations room and rest room, is pressurised. The unpressurised lower section contains the radar equipment, APU[2] and weapon bays.

The three-spar wing structure has conventional type ailerons, slotted flaps over 75 per cent of the span and air brakes above and below each wing. Each half-wing has three hinged spoilers on its upper surface, forward of the flaps. The tailplane is of conventional design with fixed incidence. Wing and all tailplane leading edges are equipped with the Kléber-Colombes pneumatic de-icing system. Ailerons, elevators and rudder are operated by twin-cylinder jacks, which are in turn operated by two separate hydraulic circuits at a pressure of 3,000 lbs/sq in; there are no trim tabs. The Hispano-Suiza tricycle landing gear comprises twin nose wheels retracting to the rear and twin main wheels, retracting forwards into the engine nacelles.

A 200 hp APU[2], installed in the forward starboard side of the lower section of the fuselage, provides compressed air for engine start and air conditioning for the aircraft when on the ground. It drives a 20 kVA alternator and a 4 kW generator which supply the emergency electrical system. Each Tyne turboprop engine drives generators which provide 28.5 V DC, 115-200 V variable-frequency AC and 115-200 V stabilised frequency AC supplies. The fuel is contained in six integral tanks with a total capacity of 4,600 Imp/gals. Each engine has an independent fuel-feed system, but the two circuits may be connected by an electrically operated cock.

Construction of the airframe is principally from bonded honeycomb material on the failsafe principle and every precaution has been taken to ensure a maximum fatigue life.

Notes to the text

1. "double-bubble" configuration fuselage – фюзеляж в виде восьмерки
2. APU = auxiliary power plant – вспомогательная силовая установка

I. Complete the following sentences:

1. The Brequet 1150 Atlantics is … .
2. The upper section of the fuselage … is pressurised.
3. The three-spar wing structure has … .
4. Wing and all tailplane leading edges are … .
5. A 200 hp auxiliary power plant, installed in the front starboard site of the lower section of the fuselage … .
6. Each engine has … .

II. Choose the right variant.

1. The "double-bubble" configuration fuselage has a boom extension
   a) beyond the tailplane
   b) above the wing
   c) in the middle of the cockpit
2. The unpressurised lower section contains
   a) the ratio and TV
   b) the radar equipment
   c) the computer
3. Wing and all tailplane leading edges are equipped with
   a) a) twin-cylinder jacks
   b) hydraulic circuits
   c) pneumatic de-icing system
4. The Hispano-Suiza tricycle landing gear comprises
   a) ailerons
   b) elevators and rudder
   c) twin nose wheels

5. The fuel is contained in
   a) six integral tanks
   b) the tail unit
   c) the landing gear

III. Speak about:
1. mid-wing monoplane Atlantic
2. Three-spar wing structure
3. 200 hp auxiliary power plant
4. Construction of the airframe

IV. Translate in written form

ASW equipment

To wage successful anti-submarine warfare an aircraft must be able to navigate with great precision and preferable without external aids – which may, in any case, be lacking in wartime.

An aircraft for ASW missions requires two distinct navigational modes. On one hand, the aircraft must be able to proceed to a predetermined ocean zone, carry out a systematic search, and destroy the enemy submarine before returning to base. Each of the three phases will be carried out by conventional navigational methods. On the other hand, detection of a target capable of rapid disappearance implies that the aircraft should reach the target's position with the minimum approach deviation: this is a question of tactical navigation.

To cover all these requirements, the Breguet 1150 uses a variety of navigational aids.

Read and translate the text C

BOEING 2707-300

The designer of the new Boeing aircraft selected a fixed delta wing of moderate wing-span with novel high-lift devices[1]. The 2707-300 has a horizontal flying tail surface. The engines are to be located under the wing and not as previously, under the tailplane.

The cabin is 176 ft (53.6 m) long five seats per row are arranged along the greater part of its length, giving a total capacity of 234 passengers in the all-tourist class configuration, with space to accommodate five toilets and five galleys. A lower forward under-floor containerized cargo compartment has a capacity of 1053 cu ft (30 m^3), and a lower rear cargo compartment provides another 300 cu ft (8,5 m^3).

A special and unusual feature of the new design is a potential for the aircraft to be built[2] in a variety of fuselage lengths and diameters.

The cockpit arrangement is conventional, with stations for two pilots and a flight engineer, and with further seating for two observers behind the captain's seat. In subsonic flight the field of vision through the pilots' windscreen is 22 degrees below and 16 degrees above the altitude datum line[3]. To increase the forward vision for taxying, take-off and landing, the nose cone can be lowered and raised.

The General Electric GE4/J5P engines with afterburners[4], are mounted in individual pods. An auxiliary drive system (ADS) is mounted alongside each engine, towards the trailing edge of the wing, driven by a shaft from the engine itself, to serve two hydraulic pumps and an electric generator. The engine starter system and a booster compressor[5] for the air conditioning and pressurisation systems, mounted in each engine pod, are connected to the engines by separate gearboxes.

The fuel system consists of integral tanks in the wing and tail cone which continuously replenish four main tanks in the body of the fuselage: each engine is supplied by one of these four main tanks. Although no automatic fuel regulation system is proposed, the transfer of fuel from one tank to another has to be carried out in a particular sequence, to maintain maximum aircraft performance over the whole speed range. Early in the flight, fuel will be pumped from the forward tanks into the main tanks, to ensure that the C of G is moved to the rear, to coincide with the aft movement of the centre of pressure[6]. In cruising conditions, fuel will be transferred evenly so that centre of gravity shift is minimized, and maintained within the normal 52-57 per cent range. During descent, fuel will be transferred from the tank in the tail-cone to the main tanks, to bring the C or G forward for optimum subsonic performance.

The air conditioning and pressurisation system comprises four independent sub-systems using a supply of air bled from the engines at 593ºC (1,100 F). This air is cooled sequentially by engine by-pass air inside the engine pod, by passing through a fuel heat exchanger by cabin exhaust air and finally is brought to the required temperature by a bootstrap air cycle cooling pack[7]. The system is self compensating to maintain the distribution in the event of malfunction of any of the cooler units.

The Boeing 2707's flight control system comprises a rudder divided into three segments, for directional control[8]; an all-moving tail-plane with geared hydraulically operated elevators for longitudinal control; and spoilers and inner and outer flaperons[9] for lateral control. The outboard flaperons and uppermost rudder section are only used in slow speed flight, and are locked out of use at high speeds; and the travel of the mid and lower rudders is reduced at high speed.

Pilot commands are transmitted from the flight deck control column, via electric cables and mechanical linkage to the hydraulic servos which are connected, in their turn, to the control surfaces.

Power for the aircraft's electrical system is supplied by the four variable-speed, constant frequency, 75-kVA generators driven by the

ADS, already referred to. Should one of the generators fail, the operation of electrical systems will be unaffected.

The wing is of multi-spar sandwich panel construction, which is more efficient than conventional construction for the relatively low end load index of the fixed-wing design.

The fuselage is of semi-monocoque design, using spars and stiffened skin panels. In areas of high compression and shear effect the pannelling is integrally stiffened, titanium 6Al-4V continuous rolled sheet being the principal material used. The construction of rudder and tail planes is similar to that of the outer wing, consisting of multi-spar and sandwich panelling.

BOEING selected the conventional two main-wheel units for the landing gear. Each unit comprises twelve wheels. The gear is mounted on the basic wing structure, and retracts forward into the wheel wells with the bogie stowed in a horizontal position, and the oleo lying uppermost.

Notes to the text

1. high-lift devices – мощная механизация крыла
2. a potential for aircraft to be built… -возможность строить самолет с …
3. altitude datum line – строительная горизонталь фюзеляжа
4. afterburner – форсажная камера
5. a booster compressor – вспомогательный компрессор
6. to coincide with aft movement of the centre of pressure – совпадать со смещением назад центра давления
7. a bootstrap air cycle cooling pack – турбохолодильная установка
8. directional control – управление курсом /удерживание самолета на курсе/
9. flaperons – элероны, флапероны

I. Translate the following word combinations:

1) total capacity; 2) a lower forward unter-floor containerized cargo compartment; 3) a lower rear cargo compartment; 4) engines are mounted in individual pods; 5) the transfer of fuel has to be carried out in a particular sequence; 6) power is supplied by the four variable-speed, constant frequency, 75-kVA generators driven by the auxiliary drive system (ADS); 7) the wing is of multi-spar sandwich panel construction.

II. Match two halves of the sentence

1. The designer of the new Boeing aircraft selected…	1. alongside each engine, towards the trailing edge of the wing.
2. The engines are to be located…	2. four independent subsystems using a supply of air.
3. An auxiliary drive system is mounted…	3. a fixed delta wing of moderate wing-span.
4. The fuel system consists of …	4. of semi-monocoque design.

5. The air conditioning and pressurisation system comprises …
6. Pilot commands are transmitted …
7. The fuselage is …

5. under the wing and not under the tail plane.
6. integral tanks in the wing and tail cone.
7. from the flight deck control column, via electric cables.

III. Speak about the main features of the new Bowing 2707-300.

IV. Translate the following text in written form.

The Boeing Company

The Boeing Company was founded by Bill Boeing, a wealthy lumberman from Washington State, on the West Coast of the U.S. The first plane was used to take him on fishing trips to remote aeras of Canada. In 1916, he set up an airplane factory in Seattle, Washington, a city which depends on the aircraft industry. Fascinated with the technology of flying, Bill Boeing when he founded the company promised "to let no new improvement in flying and flying equipment pass us by".

During World War II, the Boeing Company established its reputation as a supplier of military aircraft. After the war, in the early fifties, Boeing made the 1st passenger jet, which soon replaced all of the propeller-driven aircraft in the passenger market. It has also built a number of spacecraft used in the U.S. space program. Over the years, the company has developed a strong reputation for reliable products and the service of those products. It has been number one in the world-wide sales for years, controlling over 50% of the market for commercial aircraft.

Aerospace products are the number one U.S. export after agricultural products. The country has a long and proud tradition of dominating the industry with technological breakthroughs leading to superior products. But this dominance is now being challenged. Airbus, a France-based European company, has bumped Mc Donnel Douglas into the third spot in the industry, and it threatens to step up the competition. Boeing executives argue that they cannot compete against the deep pockets of the four European governments that subsideze Airbus. The continuing decline of the U.S. head in aerospace has sparked an intense debate in the United States on the whole issue of the proper relation-ship between government and industry. So, the debate at Boeing and in the aerospace industry has far-reaching implications for the way the United States should manage its economic future.

Unit 6

Active vocabulary:
advisory route – заданный маршрут
airframe – планер
attachment – крепление
design – конструкция, предназначать
digital computer – цифровая вычислительная машина
ferry route – перегоночный маршрут
flight deck – кабина экипажа
gangway – проход (между рядами кресел)
guide rail – рельсовая направляющая
intake – воздухозаборник
long distance flight – полет на большую дальность
multi-purpose aircraft – многоцелевой самолет
nozzle – сопло
performance characteristics – летные данные
piston-engined aircraft – самолет с поршневым двигателем
power unit – силовая установка
scheduled route – маршрут регулярных полетов
specific fuel consumption – удельный расход топлива
start up – запускать
structural design – расчет на прочность
tail unit – хвостовое оперение
tailplane – хвостовое оперение
terminal airdrome – конечный аэродром
thrust reverser – реверсер тяги
turbo-fan engine – турбовентиляторный двигатель

Read and translate the text

Tupolev Aircraft

1. The magnificent planes built by the designers working under Andrei Tupolev have long been world-famous. Back in the twenties and thirties his planes performed a number of spectacular long-distance flights, including the first non-stop flight from Moscow to the USA – across the North Pole. In 1956 the world's first jet liner, the Tu-104, was introduced into service. From it have been developed the Tu-124, Tu-134, and Tu-154 civil airliners.

2. The Tu-134, designed for hauls between 600 and 3,200 kilometres, is powered by two outboard turbo-fan engines, each with a thrust of 6,800 kilograms. This power, combined with the powerful mechanisation of the "clean" wing, and the advanced aerodynamic design, give the plane excellent take-off and landing characteristics. Its

maximum fuel load is 13,500 kilograms, its maximum take-off run 2,100 metres.

3. The positioning of the engines in the tail unit of the fuselage and the well-thought-out attachment have reduced the level of noise and vibration in the passenger cabin (seating 72 passengers) below the accepted international standards.

4. The Tu-154 is a multi-purpose jet aircraft designed for routes from 500 to 5,500 kilometres, and is available in an economy version (seating 158 to 164 passengers), tourist-class version (seating 146 to 152 passengers),and a combined first-class and tourist version (providing 24 first-class seats and 104 tourist-class places).

5. The aircraft is powered by three rear-mounted engines, two located at the base of the tail and one in the fin. Each develops a thrust of 9,500 kilograms. Specific fuel consumption at cruising speed at an altitude of 10,000 metres is 0,79 kilograms per kilogram of thrust per hour. Its normal take-off weight is 80 tons.

6. This airliner can fly on two engines without losing altitude, and can continue flight at altitudes under 5,000 metres on only one engine. The airframe has great structural strength, all main systems are duplicated, and some are triplicated.

7. The finish of the passenger saloons meets all the demands of modern industrial design. The ventilation, pressurization, and heating systems provide a pleasant microclimate, while the high cruising speed of 1,000 kph and the rear positioning of the practically eliminate noise and vibration on the passenger deck.

8. To enable the aircraft to operate from underequipped airdromes, the Tu-154 has been fitted with an auxiliary power unit to start the engines and provide air-conditioning to the cabins while grounded, and for checking systems without starting up the main engines; also with a fuel tank filling system, and a semi-automatic system for loading and unloading containers of baggage.

9. The transport version of the Tu-154 can carry 30 tons of cargo over 1,700 kilometres. It has a freight door on the port side measuring 2,100 millimetres by 3,400 millimetres. Guide rails for loading containers or separate items of freight up to 4 tons weight, are provided on the reinforced floor of the hold.

10. The flight-control, navigational, radio, and electronic equipment of the Tu-155 ensure automatic control of flight in any weather conditions and automatic approach for landing. The crew of the aircraft consists of three men. Provision is made on the flight deck, however, for a navigator and an additional pilot.

11. The supersonic, intercontinental Tu-144 airliner has ushered in the era of supersonic passenger flight. The airliner has no tailplane since

its variable-geometry swept-back wing gives it good stability and control at both subsonic and supersonic speeds. Its cruising range of 6,500 kilometres enables the plane to cover the distance between Moscow and Khabarovsk in three hours.

12. The Tu-144 has two passenger saloons, one accommodating 18 first-class passengers, and the other 80 tourist-class passengers. The first-class cabin, however, can be converted without difficulty to accommodate 40 tourist-class passengers. For summer flights of under two hours' duration it is possible to re-seat the plane for 130 to 135 passengers.

13. The crew for the supersonic Tu0144 includes two pilots and a flight engineer. The nose section of the fuselage can be depressed for better visibility during take-off and landing, and the location of the equipment section immediately behind the flight deck facilitates access to assemblies during flight and for preflight servicing.

14. The plane is powered by four separately controlled turbojets whose air intakes are automatically adjusted to flight conditions and whose nozzles are also adjustable. Each engine is fitted with a thrust reverser. All these features ensure very economical operation and full flight safety. A semi-automatic system for loading baggage is fitted, which greatly reduces turn around time. Operationally tested high-strength aluminium alloys and titanium are used in the aircraft's construction.

I. Translate word-combinations with the terms from the text: compartment, configuration, drag, lift, pitch, roll, section, span, spar, yaw.

baggage compartment, cargo compartment, crew compartment, flight compartment, luggage compartment, passenger compartment, pilot compartment;

airplane configuration, canard configuration. High-wing configuration, low-wing configuration, mid-wing configuration, tail-first configuration;

aerodynamic drag, air drag, airfoil drag, body drag, engine drag, fuselage drag, helicopter drag, tail drag, wing drag;

aerodynamic lift, aileron lift, air lift, airfoil lift, blade lift, body lift, horizontal tail lift, profile lift, section lift, tail lift, vertical tail lift wing lift;

nose-down pitch, nose-up pitch, steady pitch;

aileron roll, steady roll, wing roll;

after section, body section, centre section, cockpit section, engine section, instrument section, nose section, power section, power-plant section, rear section, tail section, tank section;

airfoil span, tailplane span, total wing span, wing span;

aileron spar, auxiliary spar, box spar, centre spar, fin spar, front spar, leading-edge spar, main spar, rear spar, rudder spar, tailplane spar, trailing-edge spar, wing spar, wooden spar;

aerodynamic yaw, aileron yaw, negative yaw, positive yaw, steady yaw.

II. a) Translate the following English words from the text having the common root with Russian words (don't use the dictionary)

aerodynamic *a*, aerodynamically *adv*, aileron *n*, cabin *n*, center *n*, class *n*, comfortable *a*, configuration *n*, construct *v*, container *n*, effective *a*, engineer *n*, equivalent *a*, fuselage *n*, grouping *n*, horizontal *a*, illustrate *v*, material *n,* minimum *n*, moment *n*, navigation *n*, passenger *n*, pilot *n*, problem *n*, temperature *n*, tourist *n*, typical *a*, vertical *n*, vestibule *n*.

b) Find the meaning of the following words in the dictionary. They are recommended to be translate in this text this way:

Paragraph 3: lift (n) – подъемная сила
Paragraph 5: normally (adv) – обычно
Paragraph 6: control (v) – управлять
elevator (n) – руль высоты
Paragraph 8: navigator (n) – штурман
section (n) – отсек, салон

III. Translate the following words.

a) nouns and verbs:

Pattern: model – модель, моделировать.

control, flight, guide, house, land, launch, lift, load, machine, man, manufacture, mark, mount, name, record, result, rivet, screw, seat, ship, sound, space, start, support, taxi, track, travel, turn, twist, view;

b) adjectives and verbs:

Pattern: slow – медленный, замедлять.

clean, clear, complete, correct, double, dry, empty, narrow.

IV. Read the following words. Pay attention to the stress and the meaning. Learn these words by heart.

´contract – соглашение	con´tract – сжимать, сокращать
´decrease – уменьшение	de´crease – уменьшать
´increase – увеличение	in´crease – увеличивать(ся)
´detail – подробность	de´tail – подробно излагать
´extract – извлечение, выдержка	ex´tract – извлекать
´forecast – прогноз	fore´cast – предсказывать
´import – ввоз	im´port – ввозить
´object – предмет, цель	ob´ject – возражать
´perfect – совершенный	per´fect – совершенствовать
´produce – продукт	pro´duce – производить

´progress – успех, развитие	pro´gress – продвигаться вперед, развиваться
´project – проект	pro´ject – проектировать
´protest – протест	pro´test – протестовать
´record – запись, отчет, рекорд	re´cord – записывать
´subject – тема, подверженный, подлежащий	sub´ject – подвергать (воздействию), подчинять
´transfer – передача, перенос	trans´fer – передавать, переносить
´transport - перевозка	trans´port - перевозить

V. Translate the following words (adjective-noun-verb).
deep – depth – deepen, wide – width – widen, broad – breadth – broaden, long – length – lengthen, strong – strength – strengthen, high – height – heighten, short – shortness – shorten, weak – weakness – weaken, dark – darkness – darken.

VI. Translate these sentences given in different Tenses (Active Voice).
1. This book deals with the theory of the universe structure. 2. This book opens with a review of the propulsion problem. 3. This chapter has discussed some of the many possible applications of the air cushion principle. 4. Many factors have affected the heating of an airplane. 5. Navigation in space required the determination of position and velocity relative to the desired path. 6. Man has succeeded in soft-landing on the Moon. 7. In future meteorological, communications, and navigational satellites will continue to play an important role. 8. This laboratory has been operational since May 1966. 9. Satellites are already helping map-makers to plot the Earth's shape more precisely. And they are helping to prepare the way for further manned flights by gathering information about outer space. 10. Equipment on board the interplanetary space station

VII. Answer the following questions:
1. How many engines has the Tu-154 aircraft? 2. Where are the engines of the Tu-154 aircraft situated? 3. What are the advantages obtained from grouping the engines tightly round the fore and aft axis of the airframe? 4. What are the advantages in having the engines right at the back of the airframe? 5. In what manner are the wings constructed? 6. When is the taiplane deflected? 7. Whom does the normal crew include? 8. Into how many sections is the passenger cabin divided? 9. In what way do passengers board the aircraft? 10. How many baggage compartments are there in the Tu-154 aircraft?

C Read and discuss the text "The Supersonic Tu-144 makes its first flight". Express your opinion about Konstantin Razin states.

THE SUPERSONIC TU-144 MAKES ITS FIRST FLIGHT

The Tu-144 supersonic passenger plane made its maiden flight on December 31st. It lasted for 38 minutes and was the first in a series of test flights of this new aircraft, which can fly at twice the speed of sound. The Tu-144 has a cruising speed of 2,500 kph., a maximum range of 6,500 km and flies at an altitude of 20,000 metres. The tourist version of the aircraft seats 121 passengers.

This plane can ferry passengers from Moscow to Delhi in 2 hours, to Khabarovsk in 3 hrs.20 min., and to Paris in 1 hour 30 min. The Tu-144 will operate from the same airports as the Tu-104. Its take-off run is 1,900 metres, and the noise level of its engines does not contravene international regulations.

The crew's cabin is in the nose of the fuselage. It houses two pilots and the flight-engineer. When taking off and landing, the nose of the plane is lowered to provide better visibility for the pilots. The Tu-144 is equipped with automatic navigation systems. It has 4 jet engines below the fuselage. Their exhaust nozzles are so big that a man can walk freely in them. The new craft has no tailplane, but a triangular swept wing.

The air conditioning system is of great importance for a supersonic plane. In the pre-sonic craft, the air in the cabin had to be heated, but in supersonic types, it has to be cooled. This is much more complicated than heating, for, besides the heat emitted by the passengers and electronic equipment, it is also necessary to cool the heat which penetrates the walls of the fuselage. At a speed of 2,500 kph. the outer of the Tu-144 heats up to 150ºC.

At an altitude of 20,000 m, the pressure in the passenger cabins of the Tu-144 is maintained at the level it would be if the plane were flying at 2,400 metres. Should the passenger cabin become partially de-pressurized when the craft is travelling at cruising speed, the air-conditioning system operates on an emergency regime.

The Tu-144 has been designed by Andrei Tupolev, the famous general designer, and his son Alexei Tupolev, who is a chief designer.

Moscow News correspondent Konstantin Razin asked Alexei Tupolev for his opinion on prospects for the development of supersonic airliners.

"It is quite obvious that the supersonic airliner", said the chief designer, "will soon occupy a leading place in passenger transport. Today this is clear to everyone. This type of transportation offers great advantages if a plane could be made which possessed good flying characteristics, could reach supersonic speeds and provided a high degree of comfort for the passengers. Such a plane has now been produced and is past the stage requiring daring men, flying alone, who had great difficulties in flight, and were subject to danger when making a landing. It is precisely from this moment that the age of supersonic airliners begins. It will give much to man – more comfort and less flight fatigue, for it takes no more than 3 hours to fly great distances. This time span is pleasant and convenient for man, because it corresponds to human psychological inclinations which are the result of thousands of years of development. On domestic and international flights, the Tu-144 will harmoniously combine flying time with man's physiological composition".

G.: Will the speed of passenger planes continue to increase?

A.: "Right now engineering techniques make it possible to build planes to fly at speeds of 2-3,000 kph. This speed will probably be the limit for no less than 10 years. After that we will need a virtual revolution in engineering. There will be major overheating problems to solve, for the plane gets overheated at great speeds. In some cases, a further increase in speed would be senseless, for what is important for a passenger craft is not its maximum cruising speed, but its so-called average route speed, i.e., distance divided by time. If you fly by Tu-144 from Moscow to Tbilisi or Omsk, you would speed only one hour in the air. So where is it more profitable to save time – in flight or on the delivery of the passenger to his ultimate destination? Naturally, quite different problems arise in this case. There is, of course, bound to be an increase in speeds, for man will never rest content with his achievements. This will come not today, however, but in the next few decades".

D Translate the text "What's up in the air" in written from

WHAT'S UP IN THE AIR

Most of the advances we'll see in air transportation before 2000 A.D. will take to the skies within the next few years. The largest airplane ever designed for commercial service, capable of seating nearly 500 passengers, is already being built. The advanced-design Boeing 747 has a gross weight of up to 710,000 pounds, is 231 feet, 4 inches long and has a wing-span of 195 feet, inches. Its tail rises more than 63 feet above the ground – higher than the average five-story building. It is powered by four Pratt & Whitney JT9D-3 turbofan engines, each with 43,000 pounds take-off weight approximately twice the power of the largest commercial jet engines in use today. The 747 will operate from any airfield than can accommodate present international-type aircraft. It will cruise comfortably at 625 miles an hour at 40,000-foot altitudes, for ranges up to 6,000 miles.

Supersonic transport prototypes now in development will be forerunners of a new generation of 1,800 miles per hour passenger jetliners. They will be built by the Boeing Company. General Electric will build the engines, each of which will produce more than 60,000 pounds of thrust. With its newest refinements, the Boeing design is a 318-foot-long titanium airplane. The unique variable-sweep wings originally planned are under re-evaluation due to Federal qualms about structural problems. Ironically, this design feature, which helped snag the contract for Boeing, may be abandoned for a fixed wing.

With or without variable wings, the SST will cruise at about Mach 2,7, almost three times the speed of sound. Similar in concept to those on Boeing 727 jetliners, slotted trailing-edge flaps and leading edge slats bordering 85 per cent of the SST's wing will provide added lift for takeoff and landing.

The "ideal" short-haul air transport for the early 1970s probably will be a vertical or short takeoff and landing (V/STOL) aircraft that will fly 30 to 40 passengers right into the heart of a city or its suburbs on trips up to 260 miles.

Prototype for what may become a surface solution to masse transportation is the "Northeast Corridor Project", a federal-funded demonstration program to provide faster and improved railroad service in the Washington – New York – Boston area. In the Washington-Philadelphia-New York section it is a joint undertaking of the Department of Transportation and the Penn-Central Railroad.

Using 50 cars the Budd Company is building the Penn-Central will add about 30 new trains to the system, providing at least half-hourly service between New York and Philadelphia and hourly service between New York and Washington from early morning to late at night. This will represent about a 50 per cent increase in service. Between New York and Washington the half-speed (90-100 mph) trains will cut travel time from four hours to three. Between New York and Philadelphia the time will be cut to one hour and 15 minutes, compared with the one hour and 35 minutes of today's fastest trains.

All that is only a beginning. Perhaps more interesting is the Turboline, driven by the same basic gas turbines that power jet planes. This new rail car, developed by Budd, may well revolutionize commuter and intercity rail service.

Project Tuberflight, an even more interesting research project, is underway at Rensselaer Polytechnic Institute in Troy, N.Y. The scheme is one in which air-cushion supported vehicles will travel inside tubes at air transport speeds. The vehicles would be powered by air taken in through ducts and forced out the periphery of the vehicle in swirls – a method of propulsion resembling a "bladeless propeller".

Unit 7
Text A

I. Active Vocabulary

1. blade-stall – срыв потока с лопасти; 2. compound helicopter – комбинированный вертолет; 3. copter – вертолет; 4. craft – летательный аппарат; 5. to hover – зависать; 6. running landing – посадка с пробегом; 7. stall – потеря скорости; 8. tilting propeller – воздушный винт с изменяемым наклоном; 9. tilt-prop – с поворотным несущим винтом; 10. tilt-wing – с поворотным крылом; 11. vertical riser – аппарат вертикального взлета.

VTOL AIRCRAFT

1. Vertical take-off and landing aircraft (VTOL) are all those machines including the helicopter, that have the ability to rise or descend vertically and to hover in midair. They include compound helicopter, tilt-prop and tilt-wing and jet VTOL. It is significant that almost all the VTOLs are also capable of making a running take-off that requires only the shortest of runways. In fact, when space is available the running take-off is always preferred, since it is less of a strain on the aircraft and the engines and permits a greater payload. The VTOLs have the ability to land by descending vertically or by making a running landing with a very short forward roll. It should be noted that only the oldest of the VTOLs, the well-tried helicopter, has ever been in regular service.

2. Short take-off and landing (STOL) aircraft, on the other hand, are simplyspecialized fixed-wing airplanes, unrelated to helicopters or other vertical risers, designed with aerodynamic features that provide high lift and good control at very low airspeeds. The STOLs can take off and land at extreme angles and require only the shortest of runways; for some of the smaller machines as little as 200 or 300 feet may be enough. During take-off the STOL airplane requires only a short run in order to reach the low airspeed at which its wing will begin to lift. While landing, a STOL can fly so slowly, without stalling, that when it touches down it can be stopped easily after a short forward roll.

3. There are many advantages to the STOL airplane. It is less complicated and therefore less expensive than VTOL aircraft. The wings are fixed, and there are no rotors or tilting propellers – no pivoting or rotating system such as those needed for the vertical flight of the VTOLs. But it is seriously lacking in one critical area: it is incapable of vertical flight or hovering and must always keep moving in order to keep flying, however slowly. The larger STOLs, for example, could be expected to require at least 60 miles per hour of airspeed during an approach. In addition, the STOL has to have a runway on which to land, and, perhaps

more important, it must have an adequate amount of clear airspace in which to manoeuvre and line up on the runway.

4. Returning to the VTOLs, the true vertical-risers, we find that, despite their very great differences in outward appearance, we can reduce them to four primary types: standard helicopter, compound helicopter, tilt-prop airplane, and jet VTOL.

5. First in the line-up is the standard helicopter. With this aircraft, the rotor is the heart of the flight mechanism, actually serving two purposes: it provides the direct lift needed to make the machine rise vertically and to support the ship in flight, and at the same time, by "leaning forward" slightly, it propels the craft through the air. The helicopter is superior to other VTOLs in its ability to pull itself straight up or to hover in the air, it is primarily a direct-rising and hovering aircraft. This is owing to the fact that a helicopter rotor offers the lowest thrust-to-weight ratio for vertical take-off of all the various VTOL types; it can lift the most weight for the least amount of engine power. However, the copter has to pay for its superiority as a hovering machine; it is the slowest of all the VTOLs.

I. Translate the following international words into Russian.

aerodynamic a; class n; critical a; experimental a; fixed p.p.; fuselage n; individual a; mechanism n; method n; mile n; regular a; standard n; system n; turbine n; vertical a; vibration n.

II. Translate the following words with negative prefixes.

anti - antiaircraft; antibomb; antibody; antifreeze; antigravitation; antiicer; antimissile; antirocket.

de – deatomize; decentralization; decompose; decompression; deconcentration; deicer; demagnetize; demilitarize; demobilize; depressurize.

dis – desadvantage; disappear; disarmament; disconnection; discontinuity; disintegrate; dislocation; disorder; disorganization.

ir – irregular; irrelative; irresistible; irrespective; irresponsible; irrotational.

non – nonaggressive; nonatomic; nonaxial; noncombat; noncontrolled; nonlinear; nonmilitary; nonnuclear; nonregular; nonunifaorm.

un – unaccelerated; unarmed; unbalanced; uncontrolled; uncorrected; unguided; unidentified; unlimited; unmanned; unpowered; unstabilized.

III. Answer the questions.

1. What machines are VTOL aircraft?
2. Why running take-off is preferred?
3. What aerodynamic features have STOL aircraft?
4. What run does the STOL airplane require during take-off?

5. What are the four primary types of the VTOLs?
6. What purpose does the rotor of the helicopter X serve?
7. What is the helicopter superior to offer VTOLs in?
8. How does the copter have to pay for its superiority as a hovering machine?

II. Text B.

VTOL AIRCRAFT (continued)

1. An important characteristic of most VTOLs is their capability for STOL operations from short runways while making airplane-type running take-offs and landings. When operating this way, they can take off and climb out at quite severe angles, using little runways, with high payloads and without placing undue strain on the engines. This is true of the helicopter, compound helicopter, and the tilt-prop. Of these three types of VTOLs, the new tilt-props are the aircraft that might stand to benefit most from the STOL type of operation. They are the fastest in forwards flight and therefore offer the most from the viewpoint of speed and range. However, they seem to be the poorest hovering machines of the three types and might be operated as short take-off airplanes – with the propellers in the horizontal position – whenever possible with certain important benefits. The vertical take-off ability could then be saved for special situations where it would be needed. This might be where a take-of would be made in short take-off airplane configuration with a maximum gross payload.

2. This description of how a tilt-prop VTOL might be operated as a short take-off airplane in order to increase its payload touches on a crucial point: the question of whether these aircraft have any reasonable chance of economic survival, particularly if they are used for carrying passengers in scheduled service. The outstanding fact that has been learned from the experience of most helicopter airliners in the last decade is that operating costs are too high; as a result, fares are too high and passenger volumes too small.

3. One trend is toward an increase in the size of transport helicopters, for very much the same reason that transport airplanes have grown steadily in size. All things being equal, the larger the helicopter, the lower the cost per seat mile; the cost of operating new, larger aircraft ordinarily does not rise in the same proportion as the increase in passenger capacity.

4. Another basic trend, as we have noted, is the consistent effort to reduce drag so that a higher cruise speed is possible, while retaining the high-lift capability, needed for vertical take-off and hovering. The examples include the compound helicopter, with its free-wheeling rotor and additional means of thrust; the tilt-prop airplanes that can convert to a

low-drag high-speed airplane configuration for forward flight; and the jet VTOL airplanes.

5. There has also been a particularly strong engineering effort in another area: the creation of new turbo-shaft engines that are lighter and more powerful – in other words, the most power for the least weight. This, of course, benefits any type of aircraft, but it is particularly vital for VTOL machines that need great levels of thrust for a take-off that is a direct struggle against gravity.

I. Translate the sentences paying attention to the meaning:

a) Passive constructions with the following verbs: **to affect** – воздействовать на; **to follow** – следовать за; **to influence** – влиять на; **to report** – сообщать о; **to track –** следить за.

1. The speed of sound **is not affected** by a change in atmospheric pressure because the density also changes. 2. The first rocket **has been followed** by a number of smaller rockets. 3. The dynamic of the flow **may be** profoundly **influenced** by different effects. 4. Choice of the diameter of the vehicle **is influenced** by many factors. 5. The spacecraft design **is** obviously strongly **influenced** by the environment of space. 6. Drop tower experiments at high Bond numbers **were not reported**. 7. The early space vehicles **have been tracked** by ground-based radar and controlled by telemetered guidance commands. 8. The flight of the automatic interplanetary station **is being tracked** by a special centre.

b) **to account for** – объяснять; **to arrive at** - достигать чего-либо; **to deal with** - иметь дело с; **to insist (on) upon** - настаивать на; **to refer to** - ссылаться на; **to rely on (upon)** - полагаться на; **to send for** - посылать за; **to speak about (of)** - говорить о; **to write about** - писать о.

1. Flight results **must be accounted for**. 2. In this report gravity **is** satisfactorily **accounted for**. 3. The idealized structure of the fuselage **was** finally **arrived at**. 4. After all these calculations the gravitational attraction of Mars **must be dealt with**. 5. The preflight inspection of the airplane **was insisted upon** by the flight engineer. 6. Venus **is** sometimes **referred to** as the "twin planet" of the Earth. 7. The critical acceleration level **is referred to** as the "stability limit". 8. Such a device **cannot be relied upon**. 9. This rapid trajectory calculation **can be relied upon**. 10. The equipment for this experiment **was send for**. 11. The satellite defence problem **was** much **spoken about**. 12. The lunar exploration programme **has been** much **written about**.

I. Read and translate the text C.

ROTARY WING AIRCRAFT

Rotary wing aircraft are made to fly by <u>fast-turning metal blades</u>, or rotors. These aircraft can land in a small space, take off without running along the ground and stay still, or hover, in the air. The helicopter is a rotary wing aircraft which depends for its support in flight on the lift generated by one or more rotors. Besides its main, or lift rotor, the helicopter usually has an auxiliary, or tail rotor. This is a small rotor, mounted at the tail to counteract the torque of the main rotor. The tail diverts some part of engine power and lowers the powerplant efficiency. The co-axial rotor system is free from this drawback, but is not capable of high forward speed because of the drag of the widely separated rotors.

High cost of manufacture, heavy fuel consumption, restricted range and speed make the helicopter impractical for long range transportation. Even the best helicopter makes have an endurance not exceeding 3-4 hours. The helicopter is at its best mostly on short trips-city centre to airport, for instance. Sling loading is often used because it is suitable for transportation of cumbersome loads and also because it does not require a labour force on the ground.

Everyone knows the hard-working, twin-rotor helicopter Mi-12. The original plan of the Mil construction bureau for rotors at front and rear later gave way to rotors at the tips of the fixed wings. It can lift up to 40 tons and it is the largest helicopter ever flown.

Notes:

fast-turning metal blades – приводимые в быстрое вращение металлические лопасти

to counteract the torque – чтобы скомпенсировать аэродинамический крутящий момент

the best helicopter makes – лучшие модели вертолетов, выпускаемые промышленностью

sling loading – загрузка с помощью подвешиваемого на тросе груза

cumbersome load – громоздкий, негабаритный груз

II. Answer the questions.

1. What does a helicopter depend on for its support in flight?
2. Where is an auxiliary rotor mounted?
3. Why is a co-axial rotor system uncapable of high forward speed?
4. What are the main drawbacks of helicopters?
5. Where are the best helicopter makes used nowadays?