МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ АВТОНОМНОЕ
ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ
«САМАРСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
УНИВЕРСИТЕТ ИМЕНИ АКАДЕМИКА С.П. КОРОЛЕВА»
(САМАРСКИЙ УНИВЕРСИТЕТ)

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АНГЛИЙСКИЙ ЯЗЫК ДЛЯ СПЕЦИАЛИСТОВ В ОБЛАСТИ ДВИГАТЕЛЕЙ И ЭНЕРГЕТИЧЕСКИХ УСТАНОВОК

Рекомендовано редакционно-издательским советом федерального государственного автономного образовательного учреждения высшего образования «Самарский национальный исследовательский университет имени академика С.П. Королева» в качестве учебного пособия для обучающихся по основной образовательной программе высшего образования по направлениям подготовки 13.03.03 Энергетическое машиностроение, 15.03.05 Конструкторско-технологическое обеспечение машиностроительных производств, 24.03.05 Двигатели летательных аппаратов и специальности 24.05.02 Проектирование авиационных и ракетных двигателей

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Целью учебного пособия является развитие и совершенствование навыков чтения, говорения и письма.

Пособие содержит как адаптированные, так и оригинальные тексты на английском языке по актуальным проблемам современного двигателестроения. Предложенная система упражнений направлена на усвоение терминологии по двигателям внутреннего сгорания и отличается разнообразием. Может использоваться как на аудиторных занятиях по английскому языку, так и для самостоятельной работы.

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ОГЛАВЛЕНИЕ

Unit I
A SHORT HISTORY OF FLIGHT

Before Start

1. *Before you read the text, look at the title of the text and write 10 words that may be related to the topic.*

2. *Work in pairs, share the words and give your predictions about the content of the text.*

Reading

1. *Skim the text and try to guess the meaning of the words in bold.*

2. *While reading the text, define which paragraph A, B, C, D, E, F, G provides with information about:*

1. The disadvantages of balloons.
2. The attempt to make a balloon a practical transport vehicle.
3. Two lines of search of the possibility of flight.
4. The possibility to control gliders.
5. The first powered flight in an aeroplane.
6. The first actual flight in the balloon.
7. The beginning of aerial navigation.

A Short History of Flight

A The first actual flight man made was that in the **balloon**. At that time man knew that cold air pushed warm air up as warm air was lighter than cold air. That is why the first balloon that rose into the air was a hot-air balloon.

B The **invention** of the balloon was the first great achievement in regard to flight but free balloons had two main disadvantages. First, the balloon was not a practical **device** for transportation because it was almost entirely dependent on the wind. Secondly, the balloon slowly dropped as the air in the bag cooled.

C Then there came the idea **to fill** the balloon with hydrogen. Hydrogen was the lightest gas man knew. Still the balloon was not a practical air transport vehicle. There were attempts **to provide** the balloon **with** controls but they were quite useless as a means of directional control. The problem was how **to propel** the balloon.

D In the 18th century man knew that flight was possible on motionless wings with the help of air current. The **research** began to follow two lines, one, which dealt with lighter-than-air aircraft and the other with heavier-than-air aircraft.

E The real history of mechanical flight began with the 19th century. In the second half of the century there appeared gliders. The glider was a heavier-than-air aircraft which supported a man who could, to a certain extent, control it. The glider stayed in the air as it took the advantage of the air currents that rose upwardly. The glider was not a practical device either. It could not remain in still air and could not **cover** long distances.

F The invention of the engine opened the way for aerial navigation. With the help of it man had control over all directions. The greatest **success** with the lighter-than-air principle came when there appeared dirigibles. They carried engines as a means of propulsion.

G The first powered flight in a man-carrying aeroplane was made by A.F. Mozhaisky in 1884. It was 19 years before the Wright brothers'

flight. The Mozhaisky and Wright aeroplanes **led the way** into the air age. These aeroplanes had all essential features of the modern aeroplane. However, it was to take many years before the aeroplane developed into a successful, stable, **controllable**, highly maneuverable and reliable machine.

Comprehension Check

1. *Find the definition of a glider in the text. Render it in Russian.*

2. *a) Find the English equivalents for the following words and word combinations in the text.*

А) достижение, попытка, средство, поток, движение вперед, воздушная навигация, основные черты, летательные аппараты легче воздуха, маневренный и надежный аппарат Б) толкать, падать, приводить в движение, иметь дело с, появляться, проложить дорогу

b) Now say in your own words what context they are used in. If necessary, refer to the text again.

3. *Complete the following sentences using the ideas from the text.*

1. The first balloon that rose into the air was …
2. The balloon was not a practical device because …
3. The glider took the advantage of …
4. With the help of engines man had …
5. The greatest success with the lighter-than-air craft came when…
6. The aeroplane developed into …

4. *Agree or disagree with the statements. Correct the wrong ones.*

1. The first actual flight man made was that in the glider.
2. Free balloons had a lot of disadvantages.
3. Then there came the idea to fill the balloon with oxygen.
4. The real history of mechanical flight began with the 20-th century.

5. The glider was a lighter-than-air craft and could cover long distances.
6. The first powered flight in an aeroplane was made by the Wright brothers.

5. *Work in pairs. a) Translate the following questions into English and answer them according to the content of the text.*

b) Join another pair, compare the answers.

1. Какие недостатки имели воздушные шары?
2. Почему люди решили заполнять воздушные шары водородом?
3. Что человек узнал о полете в XVIII веке?
4. Когда появились планеры?
5. Каковы недостатки планеров?
6. Чему способствовало появление двигателей?
7. Кто совершил полет раньше Можайский или братья Райт?

Language Focus

1. *Match the words on the left with their definitions.*

1. transportation	a. a means of transporting people or goods, especially on land
2. vehicle	b. make an effort to do smth, try
3. to attempt	c. the line along which smth moves
4. direction	d. taking a person, animal or thing from one place to another
5. feature	e. a flying machine with wings
6. reliable	f. trustworthy, able to be relied on
7. aeroplane	g. an important or noticeable part; a characteristic

2. *Explain the difference, if there is any, between the following:*

transportation / transport
vehicle / apparatus
current / stream
feature / peculiarity
aeroplane / airship

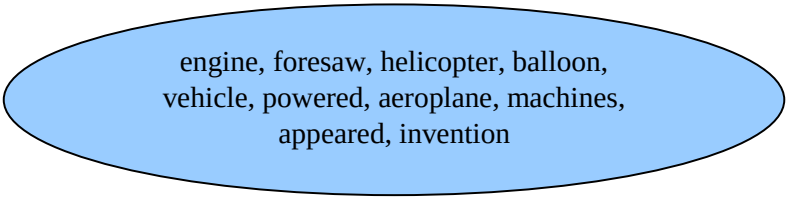
3. *a) Match a word from column A to an antonym from column B.*

A	B
1) upward	a) imperfection
2) appear	b) rise
3) cold	c) disadvantage
4) useful	d) independent
5) dependent	e) disappear
6) advantage	f) warm
7) stable	g) useless
8) perfection	h) downward
9) drop	i) unstable

b) Underline prefixes and suffixes that make words negative.

c) Choose any 3 "negative words" from the table above and use them in sentences of your own.

4. *a) Fill in the gaps in the sentences using the words in the oval. Watch out! There is an extra word.*



In the 14-th century Leonardo da Vinci 1) ____ the possibility of the man-made 2) ____ and man-made 3)____ .

Man started with the non-power-driven 4) ____ . A hot air 5) ____ was the first 6) ____ to lift man from the surface of the Earth. Then there 7) ____ winged heavier-than-air craft. Yet, the achievement of

man-directed flight came with the 8) ____. The first 9) ____ flight in a man-carrying aerop1ane was made by A.F. Mozhaisky in 1884.

b) Transcribe each word from the oval and put the stress. Learn to pronounce them.

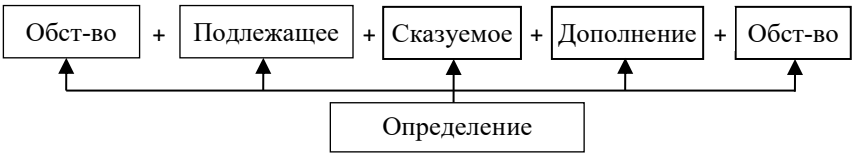
5. *a) There is one mistake in each sentence. Find it and correct.*

1. That is why the first balloon that rises into the air was a hot-air balloon.
2. Free balloons had two main disadvantage.
3. The balloon didn't a practical device for transportation.
4. The balloon slow dropped as the air in the bag cooled.
5. There was attempts to provide the balloon with controls.
6. Greatest success with the lighter-than-air principle came when there appeared dirigibles.
7. The glider stayed in the air as it taken advantage of the air currents that rose upwardly.

Grammar in Use

Английское предложение имеет фиксированный (твердый) порядок слов, который можно в приближенном виде представить на схеме.

Схема порядка слов в простом повествовательном предложении в английском языке



Подлежащее и сказуемое являются обязательными членами английского предложения, в то время как другие члены предложения

могут отсутствовать. Поэтому при переводе надо в первую очередь найти подлежащее и сказуемое.

Сказуемое – это ***единственный*** член предложения, который можно опознать по внешнему виду. Все остальные члены предложения определяются строго по месту, которое они занимают относительно сказуемого.

Сказуемым может быть любая личная форма глагола, т.е. такая форма, которая не начинается с частицы to и не имеет суффикса -ing в первом компоненте.

Например: “having been written” не будет сказуемым, т.к. начинается с компонента, имеющего суффикс “-ing”, “to write” – тоже не будет сказуемым, т.к. начинается с частицы “to”.

Глагол-сказуемое имеет ряд характеристик, так называемых сигнальных признаков, знание которых поможет распознать его.

Таблица однозначных сигнальных признаков сказуемого

shall	am	have	do
will	is	has	does
may (might)	are	had	did
must	was		
can (could)	were		
would			
should			
ought to			
need			

Кроме однозначных сигнальных признаков сказуемого существуют неоднозначные, которые могут сигнализировать либо о сказуемом, либо о других формах.

Это суффиксы “-ed”, “-s”, “-es”.

Форма с “-ed” будет сказуемым в предложении, если в данном предложении нет другой глагольной формы, которая обладает однозначными сигнальными признаками. Если такая форма есть, то она и будет сказуемым.

Например:

1. The text translated at the lesson was interesting.
2. The student translated an interesting text.

В первом предложении “translated” – не будет сказуемым, т.к. есть “was interesting” с однозначным сигнальным признаком сказуемого. Во втором предложении форма “translated” будет сказуемым, т.к. здесь нет других форм, обладающих сигнальными признаками.

Форма с “-s” или “-es” является сказуемым, если:

1) в предложении нет другой формы с однозначным сигнальным признаком;
2) перед данной формой нет артикля, притяжательного местоимения или определения;
3) перед данной формой нет предлога.

Если в предложении нет глагола ни с однозначными, ни с неоднозначными признаками, сказуемое следует искать методом исключения тех слов, которые по разным признакам не могут быть сказуемым. И тогда оставшееся слово, которое не имеет противопоказаний и может выполнять роль сказуемого, следует переводить сказуемым.

Сравним:

1. The man held a book in his hand.
   Человек держал книгу в руках.
2. They man the crews of the spaceships.
   Они комплектуют команды космических кораблей.

1. *Find the verbs that:*

a) **can perform** the function of the predicate in the sentences:

to have been translating; will have; being asked; having gone; could be answered; to be designing; are coming, ought to do, to stop.

b) **can not perform** the function of the predicate in the sentence:

was being done; will have gone; to have been asking; being given; are reading; having spoken; could be stopped; to be building; has been answered; ought to come; is giving.

2. *Find the sentences in which the word with* ***-ed*** *is a predicate.*

1. The article discussed was interesting.
2. The books recommended can be taken in our library.
3. Yuri Gagarin's first space flight opened a new era in history.
4. Experiments with this new system showed good results.
5. The mentioned book analysed a new method of glass production.

3. *Translate the sentences in which the underlined words perform the function of predicate.*

1. We usually park the car in the street.
2. People often go to the park for a walk.
3. He looked at the watch.
4. Will you watch the child?
5. They always watch all sports TV programs.
6. There was little light in the room.
7. This hall is very light.
8. Electric lamps light our streets.
9. The development of light and heavy industry depends on electricity.

Границы сказуемого

В английском предложении сказуемое может состоять из одного элемента, двух, а иногда из трех-четырех. Сказуемое бывает 2-х типов:

а) составное глагольное, в состав которого входят только глагольные элементы. Такое сказуемое строится на основе смыслового глагола. Сказуемое развертывается влево. Чем больше в нем элементов, тем дальше смысловой глагол от начала сказуемого. Итак: начало сказуемого мы ищем по одному из сигнальных признаков, а конец по смысловому глаголу;

б) составное именное, в состав которого наряду с глагольными элементами входят именные, т.е. существительные, прилагательные, числительные.

4. *Form the correct predicates.*

1. be, designed, could;
2. translated, been, had;
3. being, was, answered;
4. might, doing, be;
5. will, developed, been, have;
6. discussed, been, have, would;
7. have, asked, been;
8. done, was;
9. is, played, being;
10. gone, has.

5. *Compose the sentences out of the following words.*

1. Discussed, plan, has, the, been, just.
2. At, he, usually, this, is, reading, time.
3. England, she, been, never, have, might, to.
4. Our, not, they, often, do, place, come, to.
5. Ever, I, the, seen, film, is, have, best, it.

Сказуемое в вопросительном предложении

Местоположение сказуемого в вопросительном предложении меняется. В вопросительных предложениях сигнальный признак может стоять в начале предложения (перед подлежащим) или после вопросительных слов: what, which, when, where, why, who, how, how many, how much.

Отсутствие какого-либо однозначного сигнального признака свидетельствует о необходимости использовать глагол “do” (“did”, “does”) при образовании вопросительных и отрицательных форм.

6. *Ask questions to the underlined words.*

1. The teacher is drawing on the blackboard now.
2. The examinations will begin on the first of June.
3. The academic year begins on the first of September.
4. The students prepared their lessons at home well.
5. I have just come back from Moscow.
6. Victor Petrov is an engineer at a small plant.
7. We answered our teacher’s questions at the lesson.
8. He takes the books from the library.
9. They listen to the news over the radio at 8 o’clock in the morning.
10. This engineer designed a new airplane structural unit.

7. *Ask general questions to the following sentences.*

1. She will come here in the evening.
2. They are translating an English newspaper now.
3. My friend is a good sportsman.
4. The boy can read English in the original.
5. These students must go to the dean’s office.
6. John speaks French well.
7. He attends lectures on physics regularly.
8. They studied English a year ago.

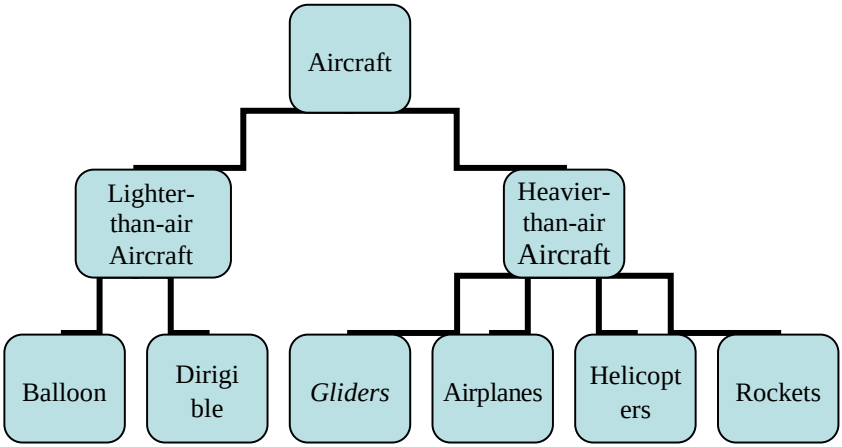
Speaking

1. *What are the most surprising facts you have learned from the text? Share ideas with your partner. Use the following expressions:*

- To my mind …
- In my opinion …
- I could hardly imagine …
- I would never believe …
- I didn't expect that …

2. *Below is the chart illustrating the main types of aircraft. Choose one of the types, search the Internet and find necessary information to be ready to speak on the type chosen. Cover such items as:*

* invention
* performances
* sphere of application.



Writing

1. *Which words go with the flying devices in the pictures? Mind, there are two extra words!*

glider, kite, balloon, dirigible, parachute, aeroplane, copter

A

B

C

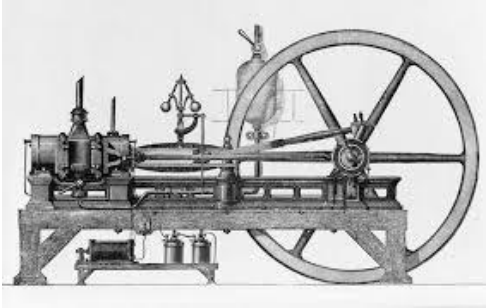
D

E

2. *Write 2-3 sentences of your own for each of the flying devices. For example:*

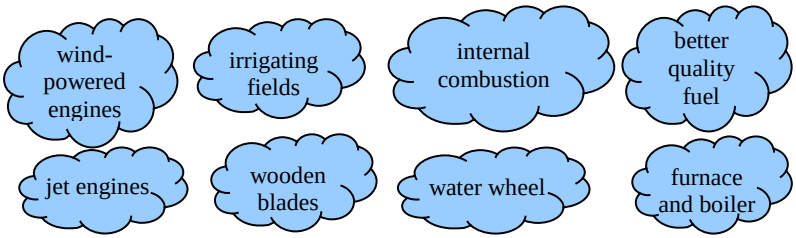
Dirigibles are lighter-than-air aircraft. They appeared in the 18-th century. Nowadays they are mainly used for advertising, sightseeing, surveillance and research.

Unit II
ENGINES



Before Start

1. *Guess which of these items might be mentioned in the text about engines. Give your reasons.*



2. *Try to answer the following questions before you read the text.*

1. What were the first engines used by people?
2 What are the advantages of present-day engines?

Reading

1. *Read the text and write out those words and word combinations you don't know but that are necessary to memorize. Try to guess their meaning from the context. Compare your notes with those of your partner.*

2. *Look through the text and find definitions of:*

- water wheel
- steam engine
- internal combustion engine
- jet engine

Engines

Do you know what the first engine was like? It was called the "water wheel". This was an ordinary wheel with blades fixed to it, and the current of a river turned it. These first engines were used for irrigating fields.

Then a wind-powered engine was invented. This was a wheel, but a very small one. Long wide wooden blades were attached to it. The new engine was driven by the wind. Some of this one can still be seen in the country.

Both of these, the water- and wind-operated engines are very economical. They do not need fuel in order to function. But they are dependent on the weather.

Many years passed and people invented a new engine, one operated by steam. In a steam engine, there is a furnace and a boiler. The furnace is filled with wood or coal and then lit. The fire heats the water in the boiler and when it boils, it turns into steam which does some useful work.

The more coal is put in the furnace, the stronger the fire is burning. The more steam there is, the faster a train or a boat is moving.

The steam engine drove all sorts of machines, for example, steam ships and steam locomotives. Indeed, the very first aeroplane built by A.F.Mozhaisky also had a steam engine. However, the steam engine had its disadvantages. It was too large and heavy, and needed too much fuel.

The imperfections of the steam engine led to the design of a new type. It was called the internal combustion engine, because its fuel ignites and burns inside the engine itself and not in a furnace. It is smaller and lighter than a steam engine because it does not have a boiler. It is also more powerful, as it uses better-quality fuel: petrol or kerosene.

The internal combustion engine is now used in cars, diesel locomotives and motor ships. But to enable aeroplanes to fly faster than the speed of sound another, more powerful engine was needed. Eventually, one was invented and it was given the name "jet engine". The gases in it reach the temperature of over a thousand degrees. It is made of a very resistant metal so that it will not melt.

Comprehension Check

1. *The text has a lot of paragraphs. Combine these paragraphs into 3 or 4 bigger logical parts. Think of an appropriate subtitle for each part. Highlight the topic words of each part.*

2. *a) Find the English equivalents to the following words and word combinations in the text.*

А) изобретать, совершать полезную работу, приводить в действие, воспламеняться, гореть, плавиться
Б) печь и котел, паровой двигатель, слишком много топлива, орошение полей, несовершенство, топливо лучшего качества, скорость звука, реактивный двигатель

b) Now say in your own words what context they are used in. If necessary, refer to the text again.

3. *Complete the following sentences using the ideas from the text.*

1. The water wheel was an ordinary wheel with…
2. The wind-operated engines are very…
3. The steam engine drove…
4. The imperfections of steam engines…
5. The advantages of internal combustion engines are…
6. The gases in jet engines reach…
7. Water – and wind-operated engines are dependent…

4. *Explain the difference between an external and internal combustion engine.*

5. *Work in pairs. Translate the following sentences into English and answer them according to the content of the text.*

1. Что представляли собой первые двигатели?
2. Каковы были достоинства и недостатки первых двигателей?
3. Из чего состоит паровой двигатель?
4. В чём заключается принцип работы парового двигателя?
5. Где используют паровой двигатель?
6. Что такое “двигатель внутреннего сгорания”?
7. В чём его преимущества перед паровыми двигателями?
8. Где используются двигатели внутреннего сгорания?

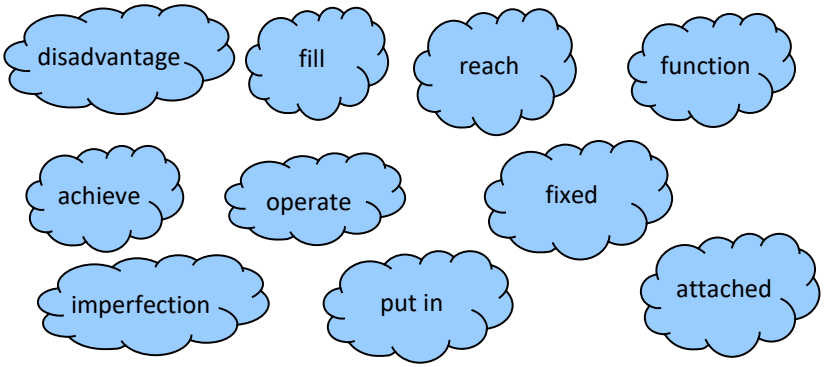
Language Focus

1. *Find the pairs of words with an opposite meaning.*

A	B
1) external	a) heavier
2) melt	b) less
3) fill	c) shot
4) lighter	d) extinguish
5) wide	e) freeze

A	B
6) ignite 7) long 8) more	f) internal g) empty h) narrow

2. *Find the pairs of words with a similar meaning.*



3. *Make sure that you know the pronunciation and stress of the words from Ex.1 and Ex.2 above.*

4. *Define which of the words in each line is the odd word.*

a) disadvantage	imperfection	fault	drawback
b) external	extended	internal	exterior
c) achieve	reach	attain	cause
d) inner	inside	outside	intrinsic
e) still	but	however	nevertheless
f) stick	fix	fasten	attach
g) work	function	serve	operate

5. *a) Match the words in column A with their definitions in column B.*

A	B
1. current 2. irrigate 3. inventor 4. attach 5. drive 6. fuel 7. furnace 8. coal 9. steam 10. melt	a. fix or join to smth else b. make smth or someone move c. the gas or vapour that comes from boiling water, used to drive machinery d. supply land with water so that crops can grow e. smth that is burnt to produce heat or power f. a hard black mineral substance used for burning to supply heat g. make or become liquid by heating h. water or air etc. moving in one direction i. be the first person to make or think of a particular thing j. a device in which great heat can be produced

b) Choose any 5 words and use them in sentences of your own.

***6**. Use the prepositions in the box to complete the sentences in the passage. Translate the passage with the help of a dictionary in writing.*

in for of from inside at into per with without toward

Nowadays there are many types 1)__ engines 2) ___use 3)___various purposes. These engine types have one thing 4)___ common. The energy is derived 5)__ a chemical reaction, which takes

place 6)___ the engine itself. Therefore all the engines 7)___ present used 8)___ aircraft can be classed as internal combustion engines. In general, internal combustion engines may be divided 9)___ piston and jet engines.

The conventional piston engines are not suitable 10)___ speeds in excess of 500 miles 11)___ hour, because of propeller limitations. It was necessary to develop power plants 12)___ propellers in order to drive airplanes 13)___ sonic and supersonic speeds.

The modern trend 14)___ aircraft power plants is 15) ___ jet propulsion primarily because 16)___ the increased speeds and great heights possible 17)___ jet engines.

Grammar in Use

Времена действительного залога

В английском языке имеется четыре группы глагольных времен: Indefinite, Continuous, Perfect, Perfect Continuous, которые образуются с помощью трех основных глагольных форм.

Основные формы глагола

Infinitive *Неопределенная форма глагола*	Past Indefinite *Прошедшее неопределенное время*	Participle II *Причастие страдательного залога*
to change – *менять* to make – *делать*	changed – *изменил* made – *сделал*	changed – *измененный* made – *сделанный*

Времена группы Indefinite

Времена группы Indefinite употребляются:

- для констатации факта совершения действия;
- для выражения обычно совершаемого действия в настоящем, прошедшем или будущем. В эту группу входят три времени: Present, Past и Future Indefinite.

Времена группы Indefinite употребляются, как правило, с обстоятельствами:

- Present Indefinite – always, usually, often, every day/week, on Mondays/Sundays, in the morning/evening, at night/at the weekend, etc.
- Past Indefinite – yesterday, last month/week, in 1960, etc.
- Future Indefinite – tomorrow, next month/week, in … days, in 2020, etc.

Формы Present Indefinite совпадают с инфинитивом без частицы to для всех лиц, кроме 3-го лица единственного числа, которая принимает окончание -s, -es.

- We begin out studies in September.
- He begins his studies in September.

По способу образования Past Indefinite все глаголы делятся на 2 группы:

- стандартные, которые образуют Past Indefinite прибавлением к основе глагола окончания -ed:
  to work – I worked, to play – he played.
- нестандартные, которые образуют Past Indefinite путем изменения корневой гласной, прибавлением окончания или другими способами.

Future Indefinite образуется при помощи вспомогательных глаголов shall для первого лица единственного и множественного числа (только в британском варианте языка) и will для всех остальных лиц и инфинитива смыслового глагола без частицы to.

Shall
Will } + Infinitive без to

He will make a report next week.
Он сделает доклад на следующей неделе.

Единственным глаголом, который изменяется не только по временам, но и по лицам и числам является глагол to be.

Спряжение глагола **to be**

Лицо	**Present Indefinite**	**Past Indefinite**	**Future Indefinite**
1 I	Am	Was	Shall be
3 He/ She / It	Is	Was	Will be
1 We	Are	Were	Shall be
2 You	Are	Were	Will be
3 They	Are	Were	Will be

1. *Insert the verb "to be" in the proper form.*

1. The new field of electronics … very promising.
2. Gamma rays … invisible electromagnetic waves.
3. Electrons … extremely light.
4. This device … made twenty years ago in the USSR.
5. Yury Gagarin … the first to penetrate into cosmic space.
6. The new types of engines … more advanced.
7. The characteristics of this unit … bad.
8. There … no difference between these two designs.
9. The compass needle points to the North. It's direction … always the same.
10. … there new instruments in your laboratory?
11. Mathematics … of great importance for engineers.

12. This … a square. All its angles … right.
13. My friends … engineers.
14. How … she now? – She … fine.

2. *Compose the sentences using the proper form of the verb "to be".*

1. (atom a great force).
2. (the students not in the laboratory).
3. (all the students present today).
4. (mr. Black a professor of mathematics).
5. (the length of a line 1.5 meters).
6. (now he at the lecture).
7. (there any figures on the blackboard)?
8. (there a picture over the bookcase)?
9. (everything in constant motion).
10. (aeronautics a new science).

3. *Translate the sentences into English.*

1. Альберт Эйнштейн был великим физиком двадцатого века.
2. Он был очень способным и закончил школу в 16 лет.
3. Моя мама – не учительница. Она – инженер.
4. К концу 1969 года второй прототип самолета был готов к испытаниям.
5. Ты сейчас очень занят?
6. Почему эти инструкции так важны?
7. Существует несколько способов обнаружения неисправностей в электронных схемах.
8. Давление в конденсаторе будет выше, чем в испарителе?

Времена группы Continuous

Времена группы Continuous выражают длительные, незаконченные действия в процессе их совершения и переводятся на русский язык глаголами только несовершенного вида.

Времена группы Continuous образуются при помощи вспомогательного глагола to be в соответствующем времени, лице и числе и Participle I (причастия действительного залога) смыслового глагола.

Present Cont.	**Past Cont.**	**Future Cont.**
Am / Is / Are + Part. I The students <u>are making</u> experiments now. *Студенты проводят опыты сейчас.*	Was / Were + Part. I The students <u>were making</u> experiments at that time. *Студенты проводили опыты в то время.*	Shall / Will + be + Part. I The students <u>will be making</u> experiments at that time tomorrow. *Студенты будут проводить опыты в это время завтра.*

4. *Choose the correct tense.*

a) Present Simple (Indefinite) or Present Continuous

1. Current (flow) in a metallic conductor.
2. The professor (speak) five foreign languages. Right now he (speak) Dutch.
3. The rocket (have) the highest speed possibilities.
4. I (not recognize) the man who (give) a talk.
5. My friend always (tell) me the truth, but I see that she (tell) a lie now.
6. I (do) a lot of work every day. Don’t worry! I (know) what (do).

b) Future Simple or Present Simple

1. In future the computers (regulate) the production process.
2. He (become) a doctor when he (grow up).
3. If you (leave) school so soon, you (forget) what you have learned.
4. Tell me if you (finish) your article in May and when exactly you (finish) it.
5. I (be) glad if some of these hopes (be) realized.
6. Tomorrow we (provide) you with all the necessary data.
7. He (complete) the experiment when they (come).
8. I (not rest) until I (prepare) my report for the conference.

c) Future Simple or Present Continuous

1. Look! The water in the tube (boil)!
2. I (give) you a lift tomorrow.
3. I'm afraid I'm not quite ready. – Never mind, I (wait).
4. I think Ann (come) at the end of the week.
5. He (leave) for London tomorrow night.
6. He says he (meet) us at the bus stop, but I'm sure he (forget).
7. Note the direction in which the piston (move) at a given moment.
8. We (have) a conference tomorrow. You (be present)?

d) Past Simple or Past Continuous

1. I (sit) on the bench for half an hour and then (begin) reading a book.
2. This copper became separated from the solution while the current (pass) through it.
3. The scientist was making a very interesting experiment when they (enter) the lab.
4. He (come) in and (see) Nelly who (draw) a strange picture.
5. We (walk) in silence for 5 minutes, then he (speak).
6. The businessman (fly) to England yesterday.
7. I (not hear) what he (say), I (type) at the moment.

8. We (look for) a more simple method of solution but could not find it.
9. My friends (work) here at that time.

Времена группы Perfect

Времена группы Perfect выражают действия, законченные к определенному моменту в настоящем, прошедшем и будущем и переводятся на русский язык только глаголами совершенного вида.

Времена группы Perfect образуются при помощи вспомогательного глагола to have в соответствующем времени, лице и числе и Participle II (причастия страдательного залога) смыслового глагола.

Present Perfect	**Past Perfect**	**Future Perfect**
Have / Has + Part. II	Had + Part. II	Shall / Will have + Part. II
We have finished our experiment.	We had finished our experiment by 5 o'clock. We had finished our experiment before he came.	They will have completed their experiment by the end of the week.

Present Perfect употребляется:

- со словами, выражающими период времени, не закончившийся к настоящему моменту this week/month/year, today;
- с наречиями неопределенного времени, которые обычно стоят между вспомогательным и смысловым глаголом: often, seldom, always, never, ever, just, not yet, sometimes;
- с предлогом “since” “с” и с союзом ‘since’ ‘с тех пор, как’, а также с предлогом “for” “в течение”: I haven't seen him for 2 years. Я не видел его в течение двух лет.

Past Perfect употребляется, когда действие было закончено к какому-то моменту в прошлом (момент выражен обстоятельством с предлогом ‘by’ ‘к’), или одно действие совершилось раньше другого в прошлом.

5. *Choose the correct tense.*

a) Past Simple or Present Perfect

1. He (forget) his French since he (leave) Paris.
2. I can reach my work easily now, as I (buy) a new car.
3. What you (do) last night?
4. We (get) a fax from Boston an hour ago, but we (not answer) it yet.
5. Electronics (undergo) more revolutionary steps than any other industry.
6. How’s Jack? When you (see) him? – Oh, I (not meet) him for ages.
7. They (complete) their experiment by now.
8. He (graduate) from the university in 2017.

b) Present Perfect or Past Perfect

1. You ever (see) a flying saucer?
2. He looked at the girl and understood he (see) her somewhere before.

3. We (translate) all the articles by 6 o'clock yesterday.
4. She said they (walk) 3 miles.
5. She came to our town three years ago. By then she already (graduate) from the institute.
6. Three methods recently (use) by our team to overcome the problem.
7. I'm sure we already (discuss) everything we needed.
8. By the time we arrived, they (complete) the experiments

c) Past Simple or Past Perfect

1. At six o'clock he (know) they were not coming.
2. We (finish) our experiment before he (come).
3. Tom wasn't at home when I (arrive). He just (go).
4. There was nobody in the sitting-room when I (get) home. Everybody (go) to bed.
5. Before we (take) Paul to the theater, he never (see) a play on the stage.
6. We felt happier when they (leave).
7. Margaret was late for work. Her friend (be) very surprised. She never (be) late before.
8. They (complete) their research by the beginning of the conference.
9. By the time we (arrive) they (complete) their experiment.

Времена группы Perfect Continuous

Времена группы Perfect Continuous выражают длительное действие и переводятся на русский язык глаголом несовершенного вида в настоящем, прошедшем и будущем времени соответственно.

Времена группы Perfect Continuous образуются при помощи вспомогательного глагола to be в соответствующей форме Present, Past или Future Perfect и Participle I смыслового глагола.

Present Perfect Cont	Past Perfect Cont	Future Perfect Cont
Have / Has } been+Part I	Had been + Part. I	Shall / Will } have been + Part. I
He has been working at this problem for 2 years. *Он работает над этой проблемой вот уже два года.*	He had been working at this problem for 2 years before he managed to solve it. *Он работал над этой проблемой два года, прежде чем ему удалось решить ее.*	When you return to the laboratory, we will have been making experiments for an hour. *Когда ты вернешься в лабораторию, мы уже будем проводить опыты в течение часа.*

6. *Choose the correct tense.*

Present Perfect or Present Perfect Continuous.

1. They (investigate) the problem for two years.
2. The students (study) the property of metals for two days.
3. The astronomers (determine) the distance between the sun and the Earth.
4. Science (achieve) great success in space research.
5. We (enter) the age of thinking machines.
6. What (happen) to the fridge?
7. I know him well. I (know) him since our childhood.
8. Ann (fail) her exam three times because she is so bad at doing sums. But she (practice) for a week now, I hope she will pass it in the end.

7. *Translate from Russian into English.*

1. Ты сделал очень много ошибок в своей предыдущей работе?

2. В этой библиотеке мало французских книг.
3. Вы когда-либо летали на самолете? – Нет, я боюсь летать.
4. Сегодня я не выходил из дома, поскольку идет дождь и у меня много дел.
5. Эти студенты делают упражнения или переводят текст?
6. В будущем году я поступаю в магистратуру.
7. Я уже говорил им об этом два раза.
8. Я закончил работу и пошел домой.
9. За последнее время мой брат выучил много новых английских слов.
10. Не звоните мне вечером. Я буду занята.
11. Я не видел ее с тех пор, как уехал в Москву.
12. В этом регионе часто идут дожди.
13. Наконец мы получили новое оборудование к концу месяца. Мы ждали его уже несколько недель.
14. Я все еще буду работать, когда ты приедешь.
15. К двум часам мы уже проведем испытание.
16. Они обсуждали этот вопрос с двух до трех часов.
17. Мы уже завершили сборку двигателя, когда в цех пришел главный инженер.
18. Мы используем данный метод с 1990 года.
19. Когда эксперимент завершается, мы изучаем полученные результаты.
20. Наш руководитель никогда не опаздывает. Он очень пунктуален.

Speaking

Work in pairs and make up a dialogue discussing advantages and disadvantages of different types of engines. Cover such items as:

- construction
- characteristics
- application

Mind, the structure of your dialogue should include:

* greetings
* some general information
* topic of the assignment
* saying good buy

Use the following phrases in the box to express your opinion.

As I see it…	You are right.
I am sure/not sure …	That's true.
I consider (that)…	Absolutely.
It seems to me …	No doubt about it.
To my mind…	I'm not sure about it.
In my opinion…	I wouldn't say that.
From my point of view…	What else I'd like to…

Writing

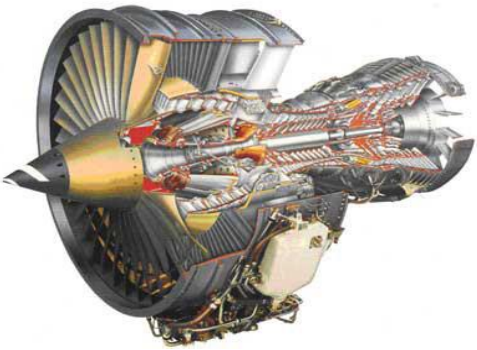
a) Match the beginnings and the endings of the sentences in A and B.

A	B
1. The first engine was…	a)… used in cars, diesel locomotives and motor ships.
2. The internal combustion engine is …	b)… dependent on weather.
3. The wind-operated engine was …	c)… a steam engine.
4. The very first aeroplane built by Mozhaisky also had …	d)… the design of a new type.
5. The imperfections of the steam engine led to …	e)… ignites and burns inside the engine itself.
6. In the internal combustion engines fuel …	f)… an ordinary wheel with blades fixed to it.

b) Develop the ideas and write down 2-3 sentences of your own. Search the Internet to get more information on the topic. For example:
In the internal combustion engines fuel ignites and burns inside the engine itself.

Internal-combustion engines are the most widely used power -generating devices. They are divided into two groups: continuous-combustion engines and intermittent-combustion engines. The most common internal-combustion engine is the four-stroke, gasoline-powered, homogeneous-charge, spark-ignition engine.

UNIT III
JET ENGINE



Before Start

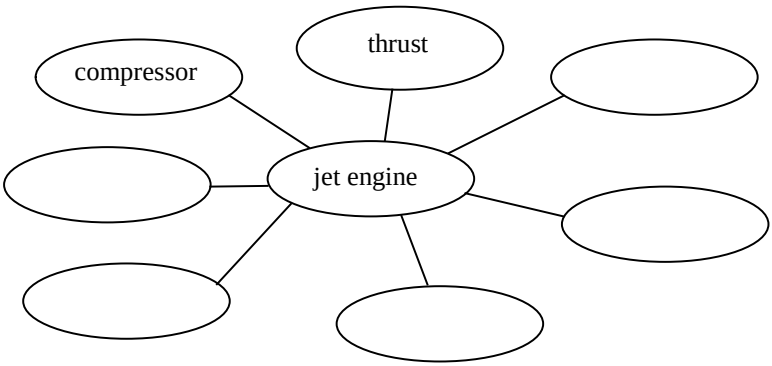
1. *Discuss the following questions with your partner.*

a) What is a jet engine?

b) What types of a jet engine do you know?

c) Where are jet engines used?

2. *Brainstorm all possible terms related to the topic.*



Reading

1. *Match the keywords with their Russian counterparts.*

1 jet	a) надежность
2 combustion	b) тяга
3 reliability	c) всасывать
4 to burn (burnt, burnt)	d) обеспечивать
5 to suck	e) выбрасывать, извергать
6 to utilize	f) реактивный; струя
7 propulsion	g) устанавливать
8 to mount	h) движение вперед
9 to produce	i) вырабатывать, производить
10 to eject	j) горение
11 to supply	k) использовать
12 thrust	l) сжигать, гореть

2. *Read the text quickly to find out how many of your ideas correspond to the given information.*

Jet Engines

A jet engine is a reaction engine that discharges a fast moving jet of fluid to generate thrust. This broad definition of jet engines includes turbojets, turbofans, rockets, ramjets, pulse and pump-jets. In general, most jet engines are internal combustion engines but non-combustion forms also exist.

The term "jet engines" refers to any jet propulsion device which utilizes air from the atmosphere together with the combustion of fuel and produces the jet for propulsion purposes.

The basic idea of a jet engine is to produce the high pressure and high temperature gas jet. The jet is ejected rearwards with great force named thrust. The thrust is the reaction of the jet of hot gases ejected from the rear. The jet is produced by combustion of the fuel in the

compressed air. The latter is supplied by the atmospheric air that enters through the front opening where a compressor is mounted. It must provide the combustion chamber with the required air. Air is sucked, compressed and then used to burn the fuel.

The air goes through the core of the engine as well as around the core. This causes some of the air to be very hot and some to be cooler. The cooler air then mixes with the hot air at the engine exit area.

Jet engines find extensive use. The application of jet power plants to aircraft has made flying faster than the speed of sound, which was once considered impossible.

Jet engines, involving the most advanced science and technology, are widely utilized not only for aircraft but also for industrial systems and equipment. In addition to the capacity to produce larger power with comparatively compact size and light weight, the high reliability and easy maintenance of jet engine will provide extreme advantage in view of automation and power economy.

Comprehension Check

1. *Say if the statements are true or false. Correct the false ones.*

1. There are several types of jet engines.
2. Being ejected rearwards the jet produces thrust.
3. The speed of a jet aircraft is less than that of sound.
4. A fast moving jet that is discharged by the engine produces thrust.
5. The air that goes around the core becomes hot.

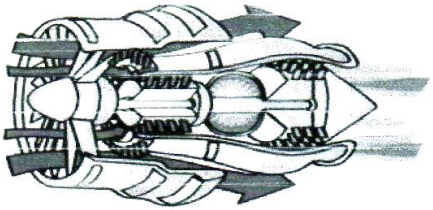
2. *Complete the sentences using the ideas from the text.*

1. Jet engines include such types as…
2. The primary purpose of a jet engine is to…
3. The term “jet engine” can be applied to…
4. The thrust is…
5. Jet engines are used today for not only aircraft but …

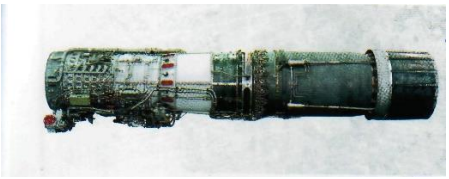
3. *a) Give the Russian equivalents to the words below. Mind their pronunciation!*

- ramjet
- core of the engine
- equipment
- large power
- advanced science and technology

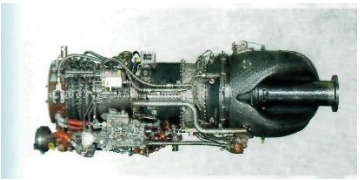
4. *Use the picture below and the active vocabulary of the lesson (Exercise 3 above and Exercise 1 in Reading) to describe the processes that occur inside the engine.*



5. *The pictures of engines, aircraft and advertisements have been mixed up. Match engines (A-D) and advertisements (1-4). Which aircraft (a-d) may these engines be installed on?*



a



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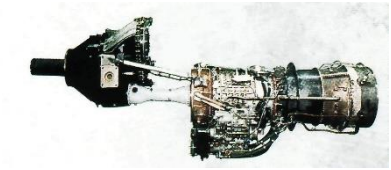

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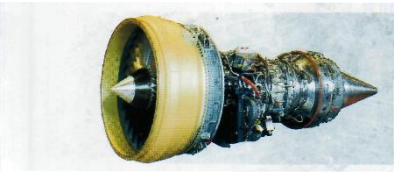


d

1. J79 Turbojet Engine

J79 is capable of producing speeds up to Mach 2 and widely adopted throughout the world, which IHI serially produced for the F-104J Star fighter and the F-4E Phantom under a license agreement with**GE.**

2. T64 Turboprop Engine

T64 is a turboprop engine serially produced by IHI to power the P-2J anti-submarine patrol plane and the UA-1A rescue flying boat under a license agreement with GE. This engine also powers the ECM/ELINT YS-11E plane.

3. CF34 Turbofan Engine

Developed and manufactured jointly for 70-90 seats class regional jet planes under Risk and Revenue Sharing Program, in which IHI plays major role as GE's partner. This engine is installed on Canadian Regional Jet CRJ 700/900, Brazilian Regional Jet EMBRAER: 170/190 and Chinese Regional Jet ARJ21.

4. T58 Turboshaft Engine

T58 is produced by IHI under a license agreement with GE, which is widely adopted to power helicopters. This engine is installed on the various kinds of helicopters such as V-107, HSS-2 and S-61.

a

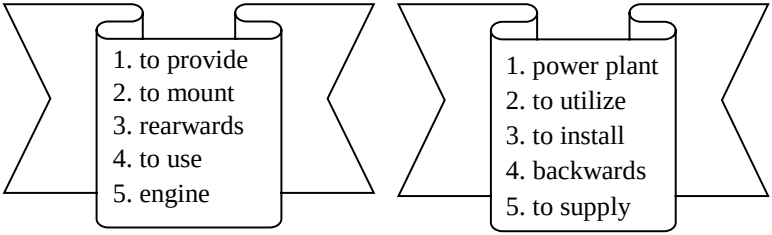
b

c

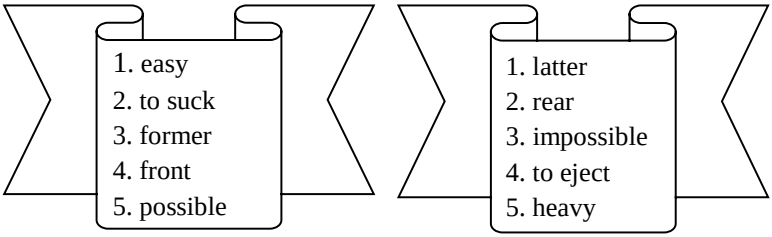
d

Language Focus

1. *Find the pairs of words with a similar meaning.*



2. *Find the pairs of words with an opposite meaning.*



3. *a) Work on your own. Choose any three words from Exercise 1 and any three words from Exercise 2. Make up sentences to show their use.*

b) Work in pairs. Exchange your sentences, check them and correct mistakes if there are any.

4. *a) Explain the following phrases in English. If necessary, consult an English-English dictionary.*

b) Give their Russian equivalents.

engine exit area reaction principle easy maintenance the speed of sound high temperature gas jet extreme advantage compressed air atmospheric air front opening extensive use jet propulsion device

Grammar in Use.

Страдательный залог

Страдательный залог (The Passive Voice) в английском языке употребляется тогда, когда внимание говорящего сосредоточено не на субъекте, а на объекте действия. Глагол в страдательном залоге показывает, что подлежащее подвергается действию, а не само его выполняет.

Сравните: He asks. – Он спрашивает.

He is asked. – Его спрашивают.

Страдательный залог образуется с помощью вспомогательного глагола to be в соответствующем времени, лице и числе и причастия II смыслового глагола, т.е. по формуле:

to be + PII

Tense	Active Voice	Passive Voice
Present Simple	V1, Vs/-,? do (does)+V1	Am/is/are+V3
Present Continuous	Am/is/are+Ving	Am/is/are+being+V3
Past Simple	V2 (ed)/-,? did+V1	Was/were+V3
Past Continuous	Was/were+Ving	Was/were+being+V3
Future Simple	Shall/will+V1	Shall/will+be+V3
Future Continuous	Shall/will+be+Ving	----------
Present Perfect	Have/has+V3	Have/has+been+V3
Present Perfect Cont.	Have/has+been+Ving	----------
Past Perfect	Had+V3	Had+been+V3
Past Perfect Cont.	Had+been+Ving	----------
Future Perfect	Shall/will+have+V3	Shall/will+have+been+
Future Perfect Cont.	Shall/will+have+been+ Ving	V3 ----------

Способы перевода страдательного залога

Страдательный залог может переводиться на русский язык:

1. Глаголом с окончанием -ся, -сь.

   All new engines are first tested.

   Все новые двигатели сначала тестируются.

2. Глаголом “быть” (в прошедшем и будущем времени) и краткой формой причастия.

   Engines were tested.

   Двигатели были протестированы (тестировались).

3. Неопределенно-личной формой глагола.

   All new engines were tested.

   Все новые двигатели тестировали.

1. *Choose the predicates in the Passive Voice.*

1. Have worked
2. Were written
3. Has been done
4. Are to negotiate
5. Was being run
6. Had finished
7. Am asked
8. Is to send
9. Had been stated
10. Were followed by

2. *Define the tense-form and the voice of the predicate.*

1. Is being discussed
2. Will be increased
3. Has had
4. Am working
5. Have
6. Has been provided
7. Had equipped

8. Was subjected to
9. Left
10. Had been overcome

3. *Match the predicates in column A with their Russian equivalents in column B.*

A	B
1. will be designed were designed are being designed	a) проектируются b) будут проектироваться c) были спроектированы
2. were being created had been created will be created	a) будут созданы b) были созданы c) создавались
3. was changed is being changed has been changed	a) изменена b) была изменена c) изменяется
4. is achieved was achieved will be achieved	a) будет достигнут b) достигнут c) был достигнут
5. will be discussed has been discussed was discussed	a) обсудили b) будут обсуждать c) обсуждали

4. *Use the verbs given in brackets in the proper tense and voice forms.*

1. The uncomplicated turbojets (to call) straight jets.
2. The turbojets (to suit) to high altitude operation.
3. All the contracts on engines delivery (to sign) by 3 o'clock yesterday.
4. You'll have your copy soon, the contract (to type) now.
5. The helicopter (to test) next year.
6. (To discuss) the plan?
7. Our planes (to provide with) the new engine by the end of this month.

8. The pulse-jet engine (to scrutinize) first seriously by American military and technical men in the late spring of 1944.
9. Disk and rim failures in turbo-jet turbines (to overcome) now by the application of such methods as improved gas seals, the incorporation of methods for cooling the disk, and improved metallurgy.

5. *Comment on the use of tenses and voice in the following sentences. Translate them.*

1. The pulse-jet engine has been given several names.
2. Air will be drawn in through the tail pipe, since the pressure within the tail pipe is low and has nothing to prevent the entry of air.
3. Once engine operation has become established, the spark plug is no longer necessary.
4. In most designs the blades are twisted to maintain a favorable angle of attack for the fluid throughout its length.
5. It is essentially a turbojet in which rotating machinery has been omitted.
6. It should be noted that in general, gas turbine-propeller engines are designed to deliver auxiliary jet thrust from the exhaust gases in additional to the propeller thrust.
7. The PS-90A2 has been designed for passenger and cargo transportation by long-haul and mid-haul airplanes.
8. The F100-PW-22 engines are out of production and are being obtained from storage at the Aerospace Maintenance and Regeneration Center.
9. The designed experimental rig is being used to determine a full of hydraulic parameters and to measure the sound pressure level.
10. While Kiwi was being run, NASA joined the effort with their NERVA (Nuclear Engine for Rocket Vehicle Application).

Глаголы с предлогами в пассиве

В английском языке существуют предложения, в которых после сказуемого в пассивном залоге следует предлог. Запомните, перевод такого предложения
начинается с предлога.

English verbs	Russian verbs
1. insist on	настаивать на
2. refer to	ссылаться на, называться
3. to rely on/upon	полагаться на
4. to send for	послать за
5. to speak of	говорить о
6. to work at/on and some other verbs.	работать над

Examples

English sentences	Russian sentences
1. These results were insisted on by many scientists.	На этих результатах настаивали многие ученые.
2. Professor Smith's article is often referred to.	На статью профессора Смита часто ссылаются.
3. This new device can be relied on/upon.	На это новое устройство можно положиться.
4. The engineer was sent for.	За инженером послали.
5. The new experiment will be spoken of.	О новом эксперименте будут говорить.
6. This problem is being worked at/on.	Над этим вопросом работают.

Кроме того, в английском языке есть такие глаголы, которые хотя и не имеют после себя предлога, на русский язык переводятся с предлогом.

English verbs	Russian verbs	Example
to attend to follow to influence to affect to watch to join	присутствовать на следовать за влиять на действовать на наблюдать за присоединиться к	The question was answered immediately. На вопрос сразу же ответили.

Часто после этих глаголов в пассиве мы видим предлог ‘by’. Он относится не к глаголу, а следующему за ним существительному, поэтому в подобных случаях мы можем начинать перевод с существительного, стоящего после ‘by’, сделав его подлежащим русского предложения.

The lecture has been attended by all the students.

На лекции присутствовали все студенты.

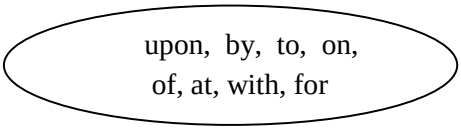
Все студенты присутствовали на лекции.

6. *Translate the sentences paying special attention to the phrases in* ***bold***.

1. Until World War II very little was **heard of** the jet engine and the piston engine was the only type used in aircraft.
2. The discovery of nanomaterials was **followed by** a number of important inventions in science.
3. These various changes are **affected by** means of the size and shapes of the duct through which the air passes on its way through the engine.
4. After the installation failed, the detailed description of apparatus was **sent for**.
5. These power plants are **looked after** by a new mechanic.
6. Pilots can activate and deactivate afterburners in-flight, and jet engines are **referred to** as operating wet, when afterburning is being used and dry when hot.
7. The students have been asked **to take part in** the discussion.

8. He has always been **interested in** aviation.
9. The new project was much **spoken of**.
10. Why don't you answer when you are **spoken to**?
11. The subject will be **dealt with** in the next chapter.
12. The buckets of the wheel are **subjected to** high centrifugal stresses.

7. *Fill in the gaps using the prepositions from the oval. In some sentences more than one preposition is possible.*



1. The problem of space exploration have just been spoken …
2. The results were affected … the presence of magnetic field.
3. This reference book have been often referred …
4. Such difficulties are met … in engine production.
5. This type of vehicle may be certainly relied …
6. The problem of aircraft noise reduction is still being worked …
7. The workers have been sent ... some instruments.
8. The body is being acted … by any number of external forces.

8. *Replace the words in brackets with their English equivalents. Use the correct tense and passive voice forms.*

1. The four-stroke engine (используется) in our last construction.
2. Such a distance (будет покрыта) in 4 hours next year.
3. The plane (оснащён) a powerful engine.
4. His warning (не придали значение).
5. Various attempts now (предпринимаются) to improve the hydrogen-boosted gasoline engine.
6. The instruction (была переведена) before the engineer (послали за).

7. Several different methods (предложены) to utilize nuclear energy for rocket propulsion.
8. The stationary vanes assembly (называется) as the turbine nozzle.
9. My friend always (интересовался) aviation.
10. The investigation of this phenomenon (будет завершено) by winter.

9. *Translate the sentences into English.*

1. Докладчиков слушали с большим интересом.
2. На решение многих вопросов повлияли практические требования и ограничения, предъявляемые современные рынком.
3. Меня никогда не спрашивали об этом.
4. После доклада вам будут задавать вопросы.
5. На эти данные уже ссылались.
6. Оборудование уже устанавливают? Как вы думаете, его установят к полудню?
7. Над проектом этой установки работают 2 года.
8. Трудности были преодолены благодаря более тщательному анализу проблем, связанных с вибрацией.
9. Работа будет завершена вовремя.
10. Новый тип форсунки был разработан совсем недавно группой инженеров.

Writing and Speaking

1. *In the text it is mentioned about several types of a jet engine. Choose one of them, search information on the Internet and write down all the facts and details necessary to cover the following items:*

* invention background
* design of early types
* drawbacks of early types
* modern types (design, technologies used, performances)

2. *Work in a group of four. Use your notes to tell your partners about the chosen engine. The phrases below may help you start and successfully continue your conversation.*

Starting a conversation
– The subject of my research is…
– Let me begin (with)…
– What I'm/was interested in is/was...
– Let's start with…
– Why don't we…?

Asking for more details
– Could you be more specific about…?
– Could you give some more details on?
– Have you come across …?
– Could you tell us how it operates?

Provoking a response
– Don't you think that…?
I can't understand your point…
You mean that…, don't you?
I have doubts about…

Unit IV
Engine Designing

Before Start

1. *Discuss the following questions with your partner.*

a) What does the aviation success mostly result from?
b) What are the stages of engine designing?
c) What innovative technologies are utilized in constructing engines?

2. *Choose from the list below the most important factors engineers should take into consideration in the process of engine designing. Explain your choice.*

* weight
* speed
* complexity
* reliability
* life
* materials the engine is made of
* cost of production

3. *Think about adjectives for the items below and their antonyms.*

Item	***Adjective***	***Antonym***
weight	light	heavy
speed		
complexity	complex	simple
reliability		
beauty		
price		
strength		

Reading

1. *Scan the text and mark the factors not mentioned before.*

2. *Read the text again. While reading match the keywords with their Russian counterparts.*

1) performance	a) совершать, выполнять
2) payload	b) режим работы двигателя
3) drag	c) загрязнять
4) to create	d) оказывать влияние
5) power output	e) летные характеристики
6) to accomplish	f) лобовое сопротивление
7) strength	g) выходная мощность
8) loss	h) вспомогательные средства
9) facilities	i) цель
10) to influence	j) достигать
11) goal	k) грузоподъемность; нагрузка
12) power setting	l) создавать
13) to reduce	m) прочность
14) to achieve	n) снижать
15) to contaminate	o) потери

Engine Designing

A. To move and fly any aircraft demands power. A machine that produces mechanical power necessary for propulsion of a vehicle is called an engine. It is constant engine evolution that decidedly influences the aircraft performance.

B. The process of developing an engine is one of compromises. Therefore, creating engines begins with solving very complex and contradictory problems – determination of the most optimum parameters permitted by modern science in the engine operating process. Then the designers work at developing such engine constructions that could accomplish this process without unnecessary loss and would have the long life and the high strength. Engineers design specific attributes into engines to achieve specific goals. Aircraft are one of the most demanding applications for an engine, presenting multiple design requirements. An aircraft engine must be:

- *reliable* − aircraft engines must perform reliably at high pressure, all temperatures and speeds;
- *lightweight* − a heavy engine increases the empty weight of the aircraft and reduces its payload;
- *powerful* − to overcome the weight and drag of the aircraft;
- *small and easily streamlined* − large engines with the substantial surface area, when installed, create too much drag, wasting fuel and reducing power output;
- *repairable* − to keep the cost of replacement down;
- *fuel efficient* − to give the aircraft the range the design requires.

C. The design of aircraft engines tends to favor reliability over performance. Long engine operation times and high power settings, combined with the requirement for high reliability, mean that engines must be constructed so that they could support this type of operation

with ease. Aircraft spend the vast majority of their time traveling at high speed. This allows an aircraft engine to be air cooled. The amount of air flow an engine receives is usually designed according to the expected speed and altitude of an aircraft in order to keep engine working at its optimal temperature.

D. Besides, engine designers, experts in the field of automatic control, measuring and information systems also take part in developing engines. They make every effort to get units that could meet all modern requirements.

E. Today we speak about the necessity to create nuclear, plasma, ion and other exotic engines. It is also quite necessary to have "clean" aircraft power plants, that is, aviation engines which do not contaminate the environment due to usage of hydrogen as the main fuel. Aircraft engine building is a fast developing branch of industry. The engine complexity doubles every 15 years. Aircraft engine designers must be well educated and able to solve the most difficult problems by using all modern knowledge, techniques and facilities.

Comprehension Check

1. *Which part of the text A-E provides with information on:*

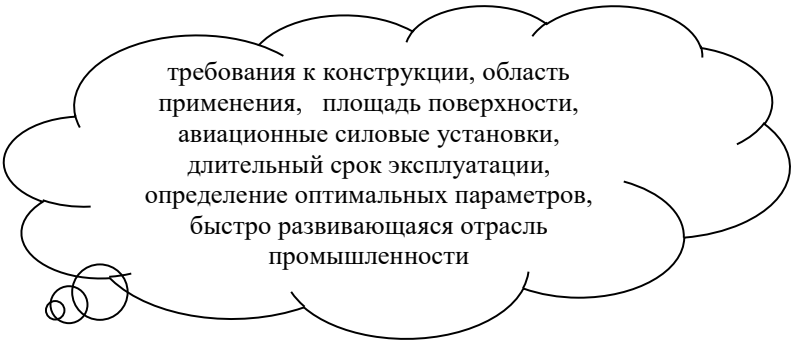
1. Basic things for engine building.
2. Innovations in engine design.
3. A machine for generating mechanical power.
4. Specialists involved in the process of engine construction.
5. Factors, providing good engine operation and reliability.

2. *Answer the questions.*

1. What kind of machine is an engine?
2. What is the primary task of any engine?
3. What other specialists (except engine designers) are involved in the construction of aviation engines?

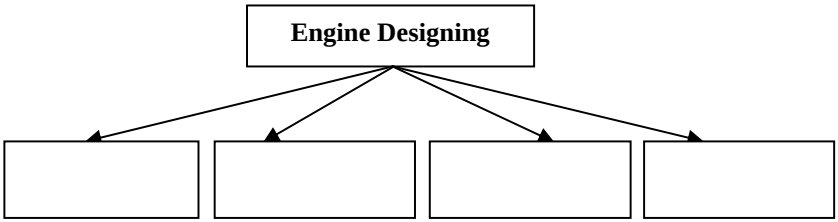
4. What qualities should aircraft engine designers possess to meet modern requirements?
5. What is new in the field of aircraft engine design today?

3. *a) Find in the text the English equivalents to the word combinations:*



b) Speak about the context in which they are used.

4. *a) Fill in the chart according to the content of the text.*



b) Compare the result with that of two other students. Speak on the topic using the chart above.

Language Focus

1. *a) Match the nouns on the left with their definitions.*

1.	aircraft	a.	something successfully finished
2.	advancement	b.	the use of physical strength or power of the mind
3.	achievement	c.	a method of doing something that needs skill
4.	effort	d.	improvement, development or movement to a higher rank facility
5.	facility	e.	a system that makes a particular activity possible
6.	loss	f.	inability to keep something
7.	techniques	g.	a flying machine of any type, with or without an engine

b) Now it's your turn to define the words.

1.	movement	a.		
2.	performance	b.		
3.	requirement	c.		
4.	strength	d.		
5.	specialist	e.		

2. *a) Put the words below into the correct column of the table.*

steam	fix	invent
exhaust	heat	change
demand	blade	export
influence	result	degree
performance	burn	melt
combustion	power	process

Verbs	Nouns	Both verbs and nouns

b) Mark the stress of all the words according to the part of speech they belong to. Practise their pronunciation aloud.

3. *Rearrange the words to get true sentences. Mind, the very first word is the beginning of the sentence.*

a) Any / propulsion / unit / a / engine / be / called / can.
b) The / were/ first / units / plants / steam / power.
c) Turbojet / the / speeds / suitable / high / engine / for / most / forward /is.
d) The /stages / an/ engine / varies / of /compressor / with / in / axial / number / design / an.
e) Fuel / chamber / in / be / combustion / must / the / burnt.
f) There / thrust / for / engine / methods / are / of / turbojet / a / increasing / some / the.
g) Thrust/ force/ an/ tending/is/ applied/ a/ produce/ in/motion/ to / body/.

Grammar in Use

Степени сравнения прилагательных и наречий

В английском языке есть три степени сравнения прилагательных и наречий: положительная, сравнительная, превосходная.

а) Односложные и часть двусложных прилагательных, оканчивающихся на ***-y***, образуют сравнительную степень при помощи суффиксов ***-er, -est:***

high - high<u>er</u> - high<u>est</u>
fast - fast<u>er</u> - fast<u>est</u>
heav<u>y</u> - heav<u>ier</u> - heav<u>iest</u>

б) Многосложные и большинство двусложных прилагательных и наречий, оканчивающихся на ***-ly***, образуют степени сравнения с помощью more (больше), less (меньше), most (наиболее), least (наименее):

interesting - more interesting - the most interesting
beautiful - less beautiful - the least beautiful

в) Некоторые прилагательные образуют степени сравнения от других корней:

good - better - (the) best
bad - worse - (the) worst
little - less - (the) least
many (much) - more - (the) most
far - farther - (the) farthest (далекий, дальний)
far - further - (the) furthest (дальнейший, добавочный)

г) Сравнительные конструкции:

1. as...as (такой же как)
2. not so...as (не такой же как)
3. more...than (более чем/ больше чем)
4. less...than (менее чем/ меньше чем)
5. the more...the better (чем больше, тем лучше)

This text is <u>as</u> big <u>as</u> the previous one.
My report is <u>not so</u> long <u>as</u> yours.
We had <u>more</u> classes yesterday <u>than</u> you.
<u>The more</u> you know, <u>the better</u>.

д) Превосходная степень может быть усилена употреблением перед нею ***by far*** или ***far***, а сравнительная степень усиливается при помощи слова ***much.***

The deposits of oil in Russia are by far the richest in the world.
Залежи нефти в России гораздо богаче всех других в мире.
Gas weighs much more than air.
Газ весит намного больше, чем воздух.

1. *Which of the words are adjectives in the comparative form?*

larger	lighter	other	glider
wider	colder	more	easier
winter	spider	over	pointer
eavier	driver	lower	further

2. *Fill in the table according to the example using either the comparative or superlative.*

a)	**high**	**higher**	**the highest**
	small great simple cheap strong		
b)	**modern**	**more modern**	**the most modern**
	efficient lightweight attractive popular significant		

3. *Translate from English into Russian. Pay special attention to the underlined phrases expressing different degree of comparative and superlative forms.*

1. CF 34-10 A power plant is a more compact, shorter engine with fewer stages and has a completely different mounting structure.

2. Plasma propulsion systems, in contrast to chemical ones, offer much greater exhaust speeds.
3. The more powerful the engine, the greater the distance the plane can cover.
4. Commercial and government best practices were evaluated and modified to fit the needs of the F100 engine program.
5. Following the financial crises in August 1998, the PS-90A engine became far more attractive for Russian operators than its Western counterparts.
6. A small amount of hydrogen added to the normal intake air and gasoline mixture greatly improves overall combustion quality by allowing nearly twice as much air for a given amount of fuel introduced into the combustion chamber.
7. This is more energy efficient way because it saves energy by reducing the amount of engine pumping needed.
8. Airbus and Boeing could have no fewer than four now wide body aircraft on sale between them.
9. The Airbus decision to develop an aircraft significantly larger than the 747-400 clearly helped to differentiate the new A380 in terms of both size and unit cost.
10. Experiments have shown that the amount of air which flows into the tail pipe can be several times as which as that which flows into the inlet.
11. Diesel engines tend to have their torque peak quite low in their speed range.
12. This provides smoother control over heavy loads when starting from rest, and, crucially, allows the diesel engine to be given higher loads at low speeds than a gasoline engine, making it much more economical for these applications.
13. Deep-space vehicles going past Mars must rely on nuclear power sources, because solar energy gets too weak at long distance from the sun.

4. *Open the brackets and use appropriate comparative and superlative forms.*

1. Most airplane materials are now made out of composite materials that are (strong) and (lightweight) than most metals.
2. Modern turboprop engines are equipped with propellers that have a (small) diameter but a (large) number of blades for efficient operation at much (high) flight.
3. It became readily apparent that a (good) job has to be done in supporting the F-100 engine fleet.
4. The problem of aircraft noise is one of the (bothersome) problems.
5. The rocket equation states the intuitive fact that the (fast) you throw propellant out from a spacecraft, the (little) you need to execute a rocket-born maneuver.
6. Air transport can and will make (far) progress.
7. Airplane can fly at (high) speed than helicopter.
8. The (great) advantage that many digital instruments have is that they don't have any moving parts.
9. The GDI (Gasoline Direct Injection) engine produces a (fine) mist of gasoline in the cylinder which leads to (clean) burning and more power.
10. The fuel cells have the (high) efficiency in power generation, reaching over 60%, compared to a gasoline-powered car which has 20%.

5. *Translate from Russian into English.*

1. Благодаря своим характеристикам, данный тип двигателя способен конкурировать с самыми лучшими мировыми двигателями этого класса.
2. Эта конструкция является более эффективной, но она и более дорогая.

3. Более холодный воздух смешивается с горячим воздухом на входе в двигатель.
4. Фронтальная область турбины намного меньше, чем фронтальная область компрессора и камеры сгорания.
5. Результатом увеличения объёма является более высокая скорость.
6. Двигатель F 100 – это самый безопасный и самый надёжный двигатель, выпускаемый для самолётов-бомбардировщиков.
7. Поскольку двигатель J 73 снабжен входными направляющими лопатками с изменяемым углом, он может разгоняться гораздо быстрее, чем раньше.
8. Последнее время самолеты-перевозчики стали пользоваться большим спросом особенно у азиатских компаний, выполняющих грузоперевозки.
9. Чем больше энергии вырабатывает турбина, тем меньше становится скорость выхлопных газов турбовентиляторного двигателя.
10. В некоторых случаях самолёты не так эффективны, как вертолёты.

Speaking

1. *Look at the three engines below. What type of engines are they? Explain your answer.*

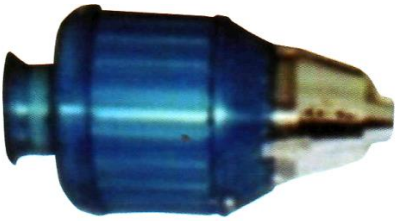


Fig. 1

Fig. 2

Fig. 3

2. *Work in pairs. The two columns below contain some advantages and disadvantages of aero engines. Match them to the engines.*

Advantages	*Disadvantages*
*powerful	*not very powerful
*streamlined arrangement	*expensive
*runs well	*complicated
*has good shape	*needs more spare parts
*small drag	*too large
*reliable	*fuel inefficient
*lightweight	*heavy enough

3. *Work with another pair of students and compare your ideas. Give some reasons to back up your point of view. The following phrases may help you start and successfully continue your conversation.*

Starting a conversation
– First of all I'd like to…
– As far as I know…
– The subject I'm going to speak about is
– I want to begin with…

Agreeing
–Yes, you are definitely right.
– I agree that…
– Maybe you are right.
– That's true.

Asking for opinions
– What do you think?
– Do you agree (with that)?
– What's your opinion on…?
–What about (you/these factors etc)?

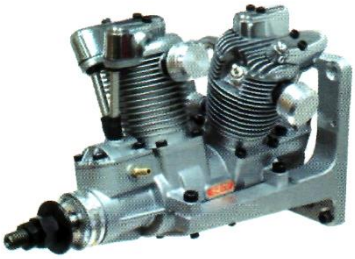
Disagreeing
– I don't think so.
– I'm not sure about that.
– No, definitely not.
– I'm afraid, I can't agree.

Writing

These are two other types of engines: a horizontally opposed twin cylinder engine and a twin engine. Compare them on the items used in Exercise 2 in Before Start. Write a short report on the work done. Use about 80-100 words.

horizontally opposed
twin cylinder

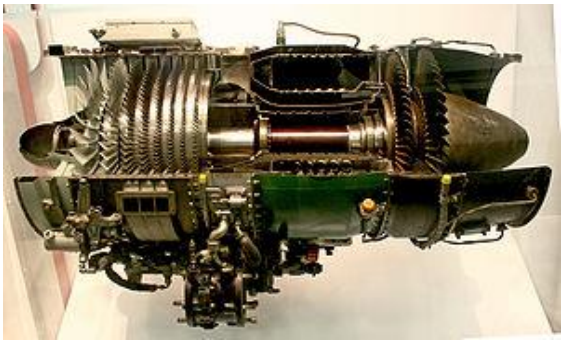
Fig. 4



V twin

Fig. 5

Unit V
POWER PLANT



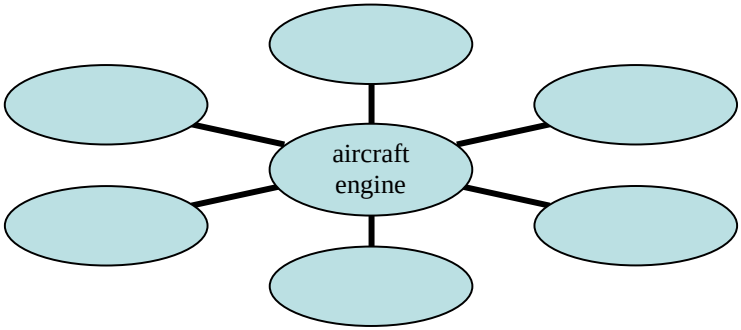
Before Start

1. *Discuss the following questions with your partner.*

a) What attributes should engineers design into engines to achieve specific goals? b) What should an aircraft power plant be?

c) What is a propulsion system in an aircraft for?

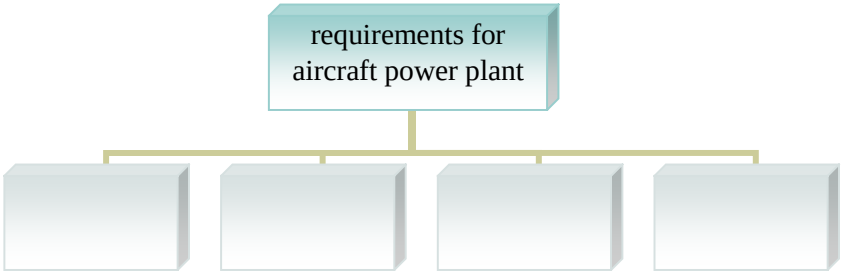
2. *Brainstorm all possible ideas related to the topic.*



Reading

1. *Read the text and check if your predictions were correct.*

2. *Read the text for the second time. While reading, fill in the chart according to its content.*



Power Plant

Any kind of vehicle must move. The ability to move demands power. A machine that produces mechanical power or energy is called an engine or a power plant. Every engine must meet a number of requirements. First of all engines must have the maximum power (or thrust) for minimum weight. Therefore every engine is to have the reduced weight per horse power of the engine. The weight in pounds per horse power output may be defined as weight/ power ratio.

Then the fuel consumption must be as low as possible. And on the contrary the amount of power produced from consumed fuel for a given period of time must be as high as possible.

Another demand is proper engine flexibility. Flexibility is the ability to run smoothly and perform properly at all speeds and through all variations of atmospheric conditions.

One more important requirement is the engine reliability. The engine is to have a long life with maximum of time between overhaul periods.

Besides, any engine must be started easily and carry its full load in a few minutes.

The necessity of carrying away excess heat developed by the engine has always been a problem of first importance too.

As mentioned before the power plant is a means of propulsion. Nowadays there exist many types of engines used for various purposes. There are gasoline engines, diesel engines, gas turbines, jet engines and rocket engines. Each of them has certain advantages and disadvantages over other forms of power plant.

Comprehension Check

1. *a) Give the English equivalents for the following Russian words and word combinations.*

А) силовая установка, аппарат для движения, величина, способность, требование, двигатель, ремонт, вес, выход, коэффициент, цель, топливо, излишек, потребление, приспособляемость, надежность
Б) определять, существовать, вырабатывать

b) Now say in your own words what context they are used in. If necessary, refer to the text again.

2. *Match the phrases on the left to the phrases on the right.*

1. All engines must have	a) may be defined as weight/ power ratio.
2. Every engine is to have	b) be as low as possible.
3. The weight in pounds per horse power output	c) with maximum of time between overhaul periods.
4. The fuel consumption must	d) the maximum power (or thrust) for minimum weight.
5. The engine is to have a long life	e) the reduced weight per horse power of the engine.

3. *Answer the questions.*

1. What machine produces thrust?
2. What must the weight of any engine be?
3. What is the engine flexibility?
4. What must the period between engine overhauls be?
5. What necessity arises due to excess heat of the power plant?
6. How can you characterize the aviation power plant?
7. What types of engines do there exist nowadays?

Language Focus

1. *Find the correct explanations on the right for the terms on the left.*

1. engine	a) a measure of the rate of doing work expressed as the work done per unit time
2. requirement	b) the amount produced, as in a given period
3. power	c) necessary changes to run smoothly and perform properly at all conditions
4. output	d) going beyond permitted limits
5. flexibility	e) a machine that produces mechanical power or energy
6. overhaul	f) examination of details or machines and if necessary to make their repairs
7. excess	g) a demand

2. *Use the terms from Exercise1 to fill in the gaps.*

a) The turbine provides the_____ to drive the compressor and accessories.

b) The steam engine could not fully meet all the _____ and it leads to the design of a new type.

c) The conventional piston engines are not suitable for speeds in _____ of 500 miles per hour because of propeller limitations.
d) The turbojet _____ is most suitable for high forward speeds.
e) Different engines have different power _____ .
f) The _____ and repair of all accessories constituting the fuel, oil and air are carried out by our company.
g) One of the most important demands in the process of engine designing is its _____ .

3. *a) Make meaningful collocations. Translate them into Russian.*

1. mechanical	a) consumption
2. reduced	b) conditions
3. fuel	c) requirement
4. engine	d) weight
5. atmospheric	e) period
6. important	f) power
7. overhaul	g) flexibility

b) Make sentences of your own to illustrate their use.

4. *Watch a video about the new auxiliary power unit APU-120 at* https://www.youtube.com/watch?v=lD7m53Gfg38 *and enumerate all unique features it possesses. What type of aircraft can it be installed on?*

Grammar in Use

Модальные глаголы

Модальными глаголами являются глаголы *can, need, should, ought (to), may, must.*

Сокращенные формы: can't, couldn't, needn't, shouldn't, oughtn't, mayn't, mustn't.

Модальные глаголы обозначают не действие, а способность, допустимость, возможность, вероятность, необходимость совершения действия.

В сравнении со смысловыми глаголами модальные глаголы имеют ряд особенностей:

а. Самостоятельно они никогда не употребляются. Только в сочетании с неопределенной формой смыслового глагола. Смысловой глагол после модальных глаголов стоит в инфинитиве *без частицы to (*исключение составляет глагол *ought to).* Модальные глаголы в сочетании со смысловыми образуют сложное глагольное сказуемое.

The weight of every engine *must be* as low as possible.

N. B. * У эквивалентов модальных глаголов частица ***to*** присутствует.

** Эквиваленты модальных глаголов имеют не только самостоятельное лексическое значение, но и восполняют недостающие временные формы этих глаголов.

Эквивалент **can – *to be able to (am /is / are able to***
was / were able to
shall / will be able to).

She will be able to help you tomorrow.

б. Модальные глаголы не изменяются по лицам и числам, т. е. в третьем лице единственного числа не имеют окончания *-s (-es).*
Fuel consumption *should be* low.

в. Вопросительную и отрицательную формы модальные глаголы образуют *без помощи других вспомогательных глаголов.*
Can scientists create an engine with inexhaustible power?

г. Модальные глаголы не имеют форм инфинитива, причастия, герундия.

д. Модальные глаголы не имеют форм будущего времени.

е. Глаголы can, may имеют форму прошедшего времени (could, might), а глагол must формы прошедшего времени не имеет.

Модальные глаголы и их эквиваленты

Modals, semi-modals- and their meanings	Present	Past	Future
Can= *be able to* 1. Мочь, уметь, быть способным 2. Разрешение 3. Сомнение, удивление	can	could	------
	am / is / are +able to	*was / were +able to*	*shall / will be able to*
May= *be allowed to* 1. Могу, можно (разрешение) 2. Возможно, наверное (50% -я вероятность)	may	might	------
	am / is / are +allowed to	*was / were +allowed to*	*shall / will +be allowed to*
Must=*have to* 1. Должен, надо, нужно 2. Должно быть, очевидно, вероятно (90%-я вероят-ность)	must	------	------
	have to / has to	*had to*	*shall/ will +have to*
Ought to=should Должен, должен бы, следовало бы	ought to should	------	------
Need Нужно, надо	need	needed	*shall / will+need*

1. *Translate the sentences paying attention to the modal verbs and semi-modals.*

1. Aircraft engines must perform reliably and safely under all reasonable conditions.
2. Aircraft engines have to operate at high power settings for extended periods of time.
3. With the absence of a radiator, aircraft engines can boast lower weight and less complexity.
4. An aircraft engine must be capable of operating at sufficient altitude for the aircraft.
5. Will your team be allowed to continue the research?
6. He has to write a detailed report on the test.
7. The engineers mustn't break the safety instructions.
8. Early engines could not consume small amount of fuel.
9. May machine tools be made of pure iron?
10. This aircraft needs no refueling.

2. *Correct mistakes in the following sentences.*

1. This new car can to move without a driver.
2. He hadn't to write a detailed report of the test.
3. She didn't can work in the laboratory on Sunday.
4. You ought be polite with other people.
5. Will be you able to make a report next month?
6. The scientist must elaborates the plan of his research.
7. The majority of metals may to become harder after they have been cold-worked.
8. Must be non-recycle plastic burnt?
9. They weren't allowed determine the constituents of this steel.
10. I think you should asked the opinion of your scientific supervisor first.

3. *Translate the sentences into English.*

1. Этот двигатель, возможно, будет установлен на новый самолёт.

2. Следует рассмотреть предложения этой конструкторской группы.
3. Углеродистая сталь не может использоваться для изготовления шасси самолета.
4. Нужно проверить показатели работы новой установки.
5. Возможно, отчёт будет завершён в срок.
6. Мы должны будем составить доклад об эксперименте через неделю.
7. Нужно провести тщательный осмотр компрессора в этой силовой установке.
   – У меня завтра экзамен.
   – Я думаю, тебе следует к нему тщательно подготовиться.
8. Мне не нужна помощь. Я сам справлюсь с этим заданием.
9. Вам не придется проверять результаты еще раз. Мы уверены, что они точные.

Модальные глаголы с перфектным инфинитивом

Modals+Perfect Infinitive

Can + Perfect Infinitive – обычно употребляется в отрицательных и вопросительных предложениях, когда говорящий выражает сомнение и переводится следующим образом: *не мог+инфинитив; не может быть, чтобы.* В вопросительных предложениях словом *неужели.*

She cannot have done this translation by herself. – Не может быть, чтобы она сама выполнила перевод.

Can she have done it? – Неужели она сделала это?

Could + Perfect Infinitive – употребляется:

а) в тех случаях, когда в прямой речи следовало бы употребить can+ Perfect Infinitive;

б) в условных предложениях третьего типа;

в) выражает очень небольшую уверенность в том, что действие произошло;

г) выражает упрек.

Peter said that Helen could not have done this translation by herself. – Питер сказал, что Хелен не могла одна выполнить этот перевод.

If she had asked me, I could have helped her translate this instruction. – Если бы она попросила меня, я бы помог ей перевести инструкцию.

How could I have forgotten about it! – Как я мог забыть об этом!

May + Perfect Infinitive выражает предположение (50% вероятности), которое относится к прошедшему времени.

They may not have finished testing the engine. – Они, вероятно/ возможно/ может быть, еще не закончили испытывать двигатель.

Might + Perfect Infinitive употребляется:

а) в тех случаях, когда в прямой речи следовало бы употребить may+ Perfect Infinitive;

б) в условных предложениях третьего типа;

в) выражает очень небольшую уверенность в том, что действие произошло.

We were told that they might not have finished testing the engine. – Нам сказали, что они, вероятно / возможно/ может быть, еще не закончили проверять двигатель.

If we were not too busy yesterday, we might have visited you. – Если бы мы не были так заняты вчера, мы, вероятно / возможно/ может быть, навестили бы вас.

Must + Perfect Infinitive выражает предположение (90% вероятности), которое относится к прошедшему времени.

They must have finished testing the engine. – Они, должно быть/ вероятно/ скорее всего, закончили испытывать двигатель.

Should /Ought (to) + Perfect Infinitive выражает критику или упрек по отношению к прошедшему.

You should have done the translation by Monday. – Тебе следовало сделать перевод к понедельнику. Ты должен был сделать перевод к понедельнику.

Needn't + Perfect Infinitive выражает отсутствие необходимости совершить действие в прошлом, хотя действие уже было совершено.

You needn't have told a lie. – Тебе не нужно было говорить неправду.

4. *Translate the sentences paying attention to modal verbs with the perfect infinitive.*

1. If all measures had been taken, this might not have happened.
2. You should have collected the necessary material before you started carrying out the experiment.
3. They could have helped us. They had enough free time.
4. The scientists may have tested the new equipment in the laboratory.
5. You needn't have provided him with this information. He is our competitor.
6. Can he have said it? You must have offended him.
7. They might have solved the problem they had to face while starting the engine.
8. Let's hurry up! She must have been waiting for us for an hour.

9. I could have given you hundreds of examples where this system had been used. But you were not interested in it then.

5. *The phrases in brackets below contain modal verbs. Replace the phrases in Russian with their English counterparts.*

1. Different types of engines (должно быть имеют) advantages and disadvantages over other forms of power plants.
2. Nuclear reactions (могут создавать) much higher temperatures than the temperatures the materials (могут) withstand.
3. The work (должно быть проводилась) in secret for a long time.
4. This kind of power plant (мог использоваться) in this engine much earlier.
5. We (следует проверить) the results once again.
6. They (не могли совершить) such a mistake. I (не могу поверить).
7. The majority of reciprocating engines (возможно являются) air cooled.
8. You (следовало бы изучить) this problem beforehand.
9. The students (не нужно было делать) all exercises in writing.
10. We (не могли терпеть) that noise any longer.

Speaking

1. *In the text it was spoken about some types of power plants. Do a search with your partner and find information on one of these forms. Cover the following items:*

*history
*design
*performance
*application

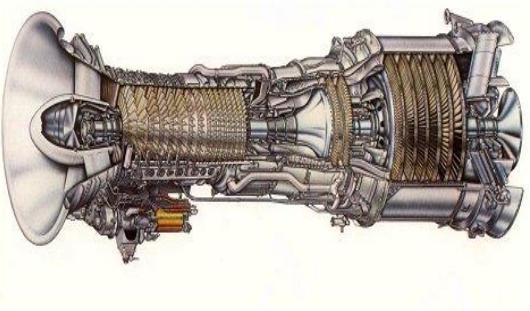
2. *Work with another pair of students and share the information on the work done.*
Phrases from Speaking (Units 2, 3, 4) help discuss the results of your research.

Writing

Rearrange the words in each line to make meaningful sentences. Write them down. Mind, the first word is the beginning of the sentence.

1. The / engine / power/ produces/ machine/ called/ is/ that/an.
2. A/ propulsion/ means/ a/ power/ is /plant/ of.
3. The/ consumption/ to/ designers/ solve/ fuel/ want/ problem/ of/ the.
4. Today's/ powered/ turbofan/ airplanes/ by/ engines/ are/ modern.
5. Do/ the/ was/ engine/ you/ know/ what/ like/ first?
6. Under/ free/ a/ years/ average/ field /conditions/ of/ brake /give / trouble / disc /should / service.
7. How/ hydraulic / might/ the /you /fuel /change?

Unit VI
GAS TURBINE ENGINE COMPONENTS



Before Start

1. *Do the Quiz. What do you know about gas turbine engines? Choose the correct answer* ***a, b, c*** *or* ***d****.*

1. The invention of the gas turbine engine goes back to
a) 1600's b) 1700's c) 1800's d) 1900's

2. In the field of aviation the idea to power an aircraft by a gas turbine belongs to
a) an Englishmen b) an American c) a Frenchmen d) a German

3. The world's first turbojet powered aircraft belonged to
a) Heinkel b) Electric Motors c) Pratt and Whitney d) Concord

4. Which of the types below *doesn't belong* to the group of gas turbine engines
a) turboprop b) turbojet c) impulse d) turboshaft

5. In gas turbine engines there is /are ….. major type(s) of compressor
a) one type b) two types c) tree types d) four types

Reading

Read the text to find out more about gas engines.

Gas Turbine Engine Components

The turbine engine consists of a rotary air compressor with an air intake, one or more combustion chambers, a turbine and an exhaust outlet.

There are two basic types of rotary air compressors: a centrifugal flow compressor and an axial flow one.

The centrifugal flow compressor is a single or two-stage unit which has an impeller to accelerate the air and a diffuser to produce the required pressure rise. The axial flow compressor is a multistage unit with alternate rows of rotating and stationary blades to accelerate and diffuse the air until the required pressure rise is obtained.

The combustion chamber has the difficult task that is to expand the air passing through the engine by burning fuel in the air stream. Although all combustion chambers work on the same principles, they may be installed in the engine in some different ways. The multiple combustion chamber layout is often used with engines having centrifugal compressors. Annular combustion chambers are used with engines having axial compressors.

The turbine provides the power to drive the compressor and accessories. It extracts energy from the hot gases released from the combustion system and expands them to a lower pressure and temperature. The turbine may consist of several stages, each using one row of stationary guide vanes and row of moving blades.

The exhaust system passes the turbine discharge gases to atmosphere at a velocity, and in the required direction, to provide the resultant thrust.

Comprehension Check

1. *a) Find the English equivalents for the following Russian words and word combinations:*

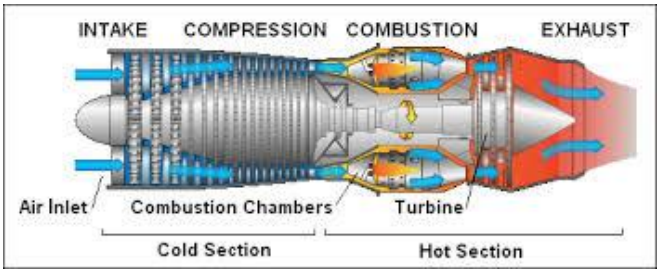
роторный компрессор воздухозаборник компрессора диффузор центробежный компрессор осевой компрессор рабочее колесо выпускное отверстие переменные ряды результирующая тяга кольцевая камера сгорания вспомогательные агрегаты двигателя выхлопные газы направляющие лопатки

b) Now say in your own words what context they are used in. If necessary, refer to the text again.

2. *Answer the questions according to the text.*

1. What components does a gas turbine engine consist of?
2. How many basic types of rotary air compressor do you know?
3. What is the function of the diffuser?
4. What types of blades are there in the axial flow compressor?
5. Where is the fuel burnt?

3. *a) The cutaway diagram shows a gas turbine engine, its main parts and processes that occur inside the engine. Give their Russian equivalents.*



b) Say some words about work each of these parts and processes does.

4. *Watch a video about the CFM-56 a turbofan engine at* https://www.youtube.com/watch?v=Wh4Furbn1Gk .
a) Fill in the table.

Component	***Function***

b) Compare a gas turbine engine and a turbofan engine on the parameters mentioned. Which of these engines has advantages over the other type?

Language Focus

1. *a) Match the verbs with their definitions.*

1. to accelerate	a) to get; acquire
2. to diffuse	b) to make or become greater in extent, volume, size, or scope; increase
3. to obtain	c) to free from smth; cause to leave
4. to expand	d) to obtain from smth. else; to withdraw
5. to provide	e) to increase the velocity
6. to extract	f) to supply; furnish
7. to release	g) to spread in all directions

b) Make up some sentences leaving a gap in each sentence for your partner to fill it in with the most appropriate verb from the table. Exchange your sentences, fill them in, check the results.

2. *Complete the sentences below using the words from the box.*

moving pressure axial energy row impeller combustion stages stream fuel air engine expand vanes

1. Annular combustion chambers are used with engines having _____ compressors.
2. The turbine extracts _____ from hot gases released from the _____ system and expands them to a lower _____ and temperature.
3. The centrifugal-flow compressor has an _____ to accelerate the _____.
4. The task of the combustion chamber is to _____ the air passing through the _____ by burning _____ in the air _____.
5. The turbine may consist of several _____, each using one _____ of stationary guide _____ and one row of _____ blades.

3. *Fill in the table with missing parts of speech where possible.*

VERB	**NOUN**	**ADJECTIVE**	**PARTICIPLE I / II**
			moving
	pressure		
		axial	
	energy		
	combustion		
expand			

4. *Read the text. Replace the underlined words with the words from the box. Translate the sentences into Russian.*

powerful	geometry	appropriate	power	components

The gas turbine engine takes air from the atmosphere and, after compressing and heating, it uses some of its energy to drive the turbine. The mechanical arrangement of the gas turbine engine is simple. It consists of two main rotating parts, a compressor, a turbine and a combustion chamber. The turbojet engine is most suitable for high forward speeds. At aircraft speeds below 450 miles per hour the jet engine is less efficient than a propeller-type engine.

Grammar in Use

Сослагательное наклонение

Сослагательное наклонение (The Subjunctive Mood) – выражает действие не реальное, а предполагаемое, условное или желаемое. На русский язык переводится ***сочетанием глагола в форме прошедшего времени с частицей «бы».***

Внешние признаки сослагательного наклонения:

а) **should, would, could, might +инфинитив без частицы «to»,** если высказывание относится к настоящему и будущему времени.

It's a pity you can't come tomorrow. Peter **would help** you.
Жаль, что вы не можете прийти завтра. Петр **помог бы** вам.

б) **should, would, could, might + перфектный инфинитив без частицы «to»,** если высказывание относится к настоящему и будущему времени.

Why didn't you phone him yesterday? He **would have helped** you.
Почему вы не позвонили ему вчера? Он **помог бы** вам.

Сослагательное наклонение в придаточных предложениях употребляется:

1. После безличных оборотов для выражения совета, упрека, морального долга:

It is	necessary important desirable required	that somebody or something	should (для всех лиц)	необходимо важно желательно требуется

It is desirable that he should be *here at 5 o'clock.*
Желательно, чтобы он был *здесь в 5 часов.*

2. После глаголов, выражающих совет, желание, приказ:

suggest, propose	предлагать
order	приказывать
demand	требовать
recommend	рекомендовать
advise	советовать
request etc.	спрашивать, запрашивать

He ***suggested that*** *the question* ***should be discussed*** *at the next meeting.*
Он ***предложил, чтобы вопрос был обсужден*** *на следующем собрании.*

3. В придаточных обстоятельственных предложениях цели **после союзов**:

so that	чтобы, чтобы не
in order that	
least	

The students brought the dictionaries **so that** they **might use** them at the lesson.
Студенты принесли словари, **чтобы** они **могли пользоваться** ими на уроке.

4. В обстоятельственных сравнительных предложениях **после союзов**:

as if	если бы как будто бы
as though	

He spoke **as if he were** a specialist on the subject.
Он говорил, **как если бы** он **был** специалистом по этому вопросу.

Придаточные предложения условия

Существуют три типа условных предложений.

Тип предложения	Главное предложение	Союзы	Придаточное предложение
Реальный (I – тип)	Will + V1	if, in case, provided, providing, unless, but for, on condition	Present Simple/Cont.
Маловероятный (II – тип)	Would/ could/might +V1		Past Simple/Cont.
Нереальный (III – тип)	Would/ could/might +have+V3		Past Perfect

N.B. **а)** В условных предложениях I типа (Conditional I) в придаточной части предложения употребляется **только настоящее время**.

He won't pass the exam **if** he **doesn't do** any work.
Он не сдаст экзамен, если не будет заниматься.

б) Условные предложения II (Conditional II) и III типов (Conditional III) **употребляются в сослагательном наклонении.** На русский язык переводятся с помощью частицы **«бы»**.

в) Conditional II отражает маловероятные условия, относящиеся к настоящему и будущему времени.

He **could run** faster **if** he **stopped smoking**.

Он **мог бы бегать** быстрее, **если бы бросил курить.**

г) Conditional III отражает нереальные условия, относящиеся к прошедшему времени.

If he **hadn't told** me, I **might have made** a mistake.

Если бы он не сказал мне, я **возможно сделал бы** ошибку.

д) Союз **"if"** в условных предложениях может опускаться, если сказуемое выражено глаголами "**were"** или **"had"**, причем эти глаголы ставятся перед подлежащим.

Had he **had** enough time, he would have attended the lectures.

Было бы у него достаточно времени, он посещал бы эти лекции.

1. *Translate the sentences. Pay attention to the Subjunctive Mood.*

1. It is suggested that chemical engines should be further divided into three groups: liquid-propellant, solid-propellant and hybrid engines.
2. It is required that any propulsion device with liquid or gaseous propellant should possess a well-designed injector.
3. The teacher advised that we should take part in the conference.
4. There is a system of valves in the engine so that burning might be controlled by closing or opening valves.
5. If the German V-2 rocket were fitted with suitable wings and controls, it could be converted into high-altitude, high-speed aircraft.
6. The rocket would follow a ballistic trajectory and descend to a height of 100,000 ft.
7. The process couldn't occur under these conditions.
8. It is important that an engineer should be familiar with improved and less wasteful processes for treating new materials.

2. *Translate the sentences into Russian. Define the type of a conditional clause.*

1. If the engine is repaired, it will work for a long time.
2. Unless the design is adopted by our chief, it will not be realized.
3. If this engine didn't consume much fuel, it would be one of the best engines today.
4. Provided the aircraft speed could be increased, the problem would be solved quite easily.
5. Had he known more on the subject, he would have joined our discussion.
6. If there were enough atmosphere, the aircraft could operate in space.
7. Provided this unit is removed, we'll immediately look for another one.
8. Unless the craft covered 150 miles per hour, it could not arrive so quickly.
9. Were the engine lighter, it could be installed on smaller planes.
10. If they didn't fit the auxiliary engine, the operation would be impossible.

3. *Use an appropriate form of the verb in brackets.*

1. Unless the new airport (to be completed), the number of airplane routes would have been lessened.
2. Provided there were not enough space in the cabin, this unit (not to be installed) in it.
3. Provided you (not to change) the fuel, the rate of burning would not be improved.
4. If there's a problem, a pilot (not can) stop flying.
5. If you (hit) a screw head with a hammer, you would probably damage it.
6. Provided the main propellant for this rocket (to be) nitrogen, it would be used for our purposes.

7. If he (not to be sure), he should have asked for clarification.
8. If there are signs of burning around the fuse or circuit breaker, (not replace) until the cable has been checked.

4. *Choose the correct conjunction and fill in the gaps. In some sentences more than one conjunction is possible.*

provided if unless in case but for so that

1. Manned rockets could not have been launched … the problem of returning to the Earth had been solved.
2. 2….the rocket would have suitable wings, one would be able to change its trajectory.
3. … the undercarriage had been installed, the landing would not have been so easy.
4. … some disadvantages were removed, this propulsion could be utilized not only for auxiliary purposes.
5. … the design could be changed, the characteristics would remain the same.
6. We would have been glad … he had managed to make the drawing in time.
7. … his fault, we could achieve good results.
8. If an assembly is broken, a technician operates it ... it works correctly.
9. ... there are some engines on board of the plane, they are located in nacelles.
10. .... our new chief comes, give him all the necessary information.

5. *Translate the sentences from Russian into English.*

1. Если бы в космосе не было вакуума, то и обычный самолет мог бы там летать.
2. Когда мы заблудились в лесу, у нас с собой была карта. Если бы не карта, мы бы не нашли дорогу.
3. Если кто-то использует термины, которые вы не понимаете, следует попросить объяснить их.
4. Если бы они не решили этот вопрос, они не смогли бы завершить эксперимент.
5. В случае, если возникнут какие-то сбои в программе, дайте нам знать.
6. Если бы тяга была сильнее, скорость аппарата была бы больше.
7. Если есть возможность, то следует использовать механизм для поднятия тяжелых грузов.
8. Если бы не гроза, самолет летел бы по курсу.
9. Я собираюсь закончить курсовую работу к концу недели, если мне ничто не помешает.
10. Будь у меня больше свободного времени, я бы написал статью быстрее.

Writing

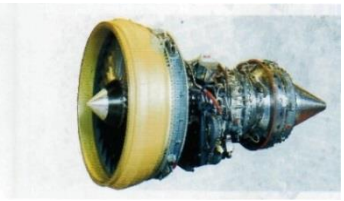
Write a short description of a gas turbine engine using ideas from the text. The following phrases may be of great help:

* The engine consists of …
* The main parts are …
* The principle of operation is …
* The function of this part is …
* The geometry of this device is …

Speaking

1. *Have a look at the pictures below. What do they show? What branches of industry are these units intended for?*

A



B

C

2. *Search the Internet to get more information on each of these units.*

3. *Discuss the results of your search in a group of four.*

The following phrases may help you start and successfully continue your conversation.

Starting a conversation

- Today I'm going to speak about …
- Let me start with...
- I'd like to tell you about …

Asking for details

- Have you come across…?
- Could you give some more details on…?
- Could you tell us how it operates?

Keeping a Conversation Going

- Now let's move on to the next point...
- As far as I know...
- The results of our search show...

VOCABULARY

Unit I
A Short History of Flight

1 achievement	достижение
2 air current	поток воздуха
3 balloon	воздушный шар
4 controls	рычаги управления, средства контроля
5 device	устройство
6 flight	полет
7 invention	изобретение
8 motionless	неподвижный
9 propel	толкать, двигать вперед
10 provide with	обеспечивать, снабжать
11 push	толкать, выталкивать
12 vehicle	летательный аппарат, аппарат для движения

Unit II
Engines

1 blade	лопатка
2 burn (burnt, burnt)	гореть, сжигать
3 drive (drove, driven)	приводить в движение
4 design	конструкция, создание
5 engine	двигатель
6 fuel	топливо
7 heat	нагревать
8 ignite	зажигать, воспламеняться
9 imperfection	несовершенство
10 melt	плавиться
11 powerful	мощный
12 reach	достигать
13 steam	пар
14 wheel	колесо

Unit III
Jet Engines

1 combustion	горение
2 eject	выбрасывать, извергать
3 jet	реактивный; струя
4 mount	устанавливать
5 produce	производить
6 propulsion	движение вперед
7 rather than	а не
8 rearwards	назад, позади
9 reaction	противодействие, действие
10 refer to	относиться, ссылаться, называться
11 supply	обеспечивать, поставлять, доставлять
12 suck	всасывать
13 thrust	тяга
14 term	термин
15 utilize	использовать

Unit IV
Engine Designing

1 achieve	достигать, выполнять
2 contaminate	загрязнять
3 develop	разрабатывать, развивать
4 drag	лобовое сопротивление
5 effort	усилие, попытка
6. facility	вспомогательное средство, средство обслуживания, оборудование
7 loss	потеря, потери
8 nuclear	ядерный
9 performance	работа, характеристики
10 power output	мощность на выходе
11 power setting	режим работы двигателя
12 range	диапазон; радиус действия
13 reliability	надежность
14 requirement	требование
15 specific goal	конкретная цель
16 streamlined	обтекаемый; имеющий обтекаемую форму
17 technique	метод, способ, техника, технология

Unit V
Power Plant

1 ability	способность
2 amount	величина, количество
3 consumption	потребление, расход
4 demand	требование; требовать
5 excess	излишек, избыток
6 fuel	топливо
7 flexibility	маневренность, гибкость, приспособляемость
8 kind	вид, тип
9 output	выход, продукция, мощность
10 overhaul	ремонт, переборка, разборка
11 perform	работать, выполнять
12 pound	фунт
13 power plant	силовая установка
14 ratio	отношение, коэффициент
15 weight	вес

Unit VI
Gas Turbine Engine Components

1 accelerate	ускорять(ся); разгонять(ся)
2 accessories	вспомогательные агрегаты двигателя
3 annular combustion chamber	кольцевая камера сгорания
4 centrifugal compressor	центробежный компрессор
5 discharge gases	выхлопные газы
6 exhaust system	выхлопная система, выхлопное устройство
7 extract	извлекать, получать
8 impeller	рабочее колесо центробежного компрессора, крыльчатка
9 install	монтировать, собирать, устанавливать
10 multi-stage unit	многоступенчатая установка
11 obtain	получить, приобрести
12 pressure rise	повышение давления
13 release	выпускать, высвобождать
14 turbine	турбина

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