ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ОБРАЗОВАНИЮ

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Утверждено Редакционно-издательским советом университета
в качестве методических указаний по английскому языку

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Целью данных методических указаний является развитие навыков чтения и письма, пополнение словарного запаса за счет изучения новых слов и закрепления уже знакомой лексики, повторение грамматических явлений, характерных для научно-технического текста, развитие и совершенствование навыков говорения.

Методические указания составлены в соответствии с современными требованиями коммуникативного подхода к изучению иностранного языка.

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Учебное издание

ЛАЗЕРНЫЕ ДВИГАТЕЛИ

Методические указания по английскому языку

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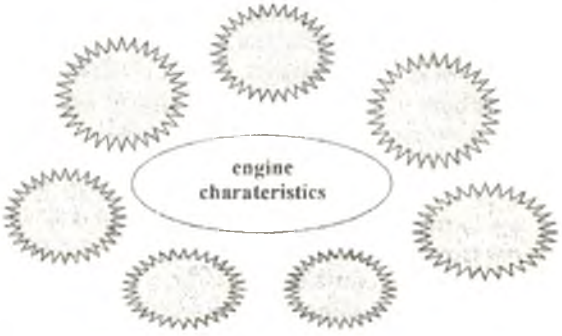
Unit I

The History of Laser Engines

Before You Begin

I. Brainstorm all possible ideas connected with different engine characteristics.



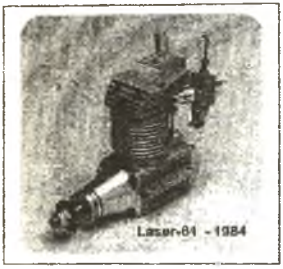
II. Scan the text to find the main featuers of laser engines. Check if your predictions were correct. Put them down.

Reading

Read the text below and answer which paragraph A, B, C, D, E , F, G, H, I, J, K, L tells you about the following:

1. The first laser engine
2.The days, when 4-stroke engine was considered a novelty
3. Modern laser engines
4. Types of aircraft used laser engines
5.The World Scale Championship
6. The Laser-75
7. Sales of laser engines
8.Engine, designed by Neil Tidey
9. The engine designed to compete with the new Japanese 120 engines
10. The cylinder head on the 75 and 90 was modified
11. The 'Quiet' silencer
12 The Nickel Silicon Carbide electro plated cylinder

The History of Laser Engines



A. Nowadays laser engines dominate International and British FAI scale competitions with a unique combination of power, reliability, simplicity of operation and extremely high quality.

B. At the World Scale Championships in Canada 5 out of the top ten models were powered by Laser engines. Laser engines have powered the winning model in 3 of the last 6 World Championships In the British National FAI Scale Championships every competitor used a Laser engine.

C. The power and reliability of Laser engines is perfect for the competition modeller, serious individual sports modeller and novice.

D. The first Laser-61 engine ran in April 1983 following many months of research into both full size and model engines. The engine was designed by Neil Tidey, a lifetime modeller with experience in engineering and marketing.This engine proved to be the most powerful 61 4-stroke ever produced with an output of 1.2bhp and 14,000rpm using fuel containing 10% nitromethane. Due to the increase in power a small silencer was fitted as standard.

E. With the aid of a Government grant the Laser-75 and 120v twin were developed to complete the initial range of engines, AGC Sales Ltd. was formed and full production commenced in 1984.

F. The 61 was fitted into a Chris Foss Wot-4 and flown at Sandown which is the major U.K. trade show. This was the first time a 4-stroke engine had been demonstrated for performance. The days when the 4-stroke engine was considered a novelty , very quiet and ideal for slow flying 'Vintage' type models were gone! A Laser-120v was demonstrated in a 1/4 scale Flair Triplane.

G. In late 1989 the Laser-62 was introduced. The cylinder head on the 75 and 90 was modified to increase the size of the inlet valve.

H. The Laser-150 was designed to compete with the new Japanese 120 engines. Only the aerobatic rules demanded a maximum capacity of 20cc (120), as the scale rules allowed unlimited engine capacity, power to weight ratio was more important than specific power output. The decision was made to produce a 150 single with high torque to run at 8,000 - 9,000rpm rather than 11-12,000rpm of the new 120 engines. This would result in higher reliability and ease of use. The 150 was designed and developed in 1991, the resultant engine being smaller and lighter than the existing 120 engines. The design allowed the development of a short stroke, very compact 120.

I. The uprated engines incorporated the new features of the Laser-150 single. The cylinder head with hardened steel rockers, valves and collets was introduced. The carburettor and silencer fixings were changed from screws to a special clip and the glow plug was placed vertical to make connection easier. The crankcases were strengthened and fully nitride hardened high tensile steel crankshafts were introduced. The engine was fitted with a larger version of the Laser 'Quiet' silencer.

J. The 'Quiet' silencer was made standard on all engines as part of our commitment to noise reduction.

K. The Nickel Silicon Carbide electro plated cylinder was introduced to the Laser-150 in early 1993 to reduce weight and give improved cooling. This plating is very thick and formed direct onto the aluminium eliminating the need for a steel cylinder to back the plating. Due to the high cost it was initially offered as an option but was made standard by the end of the year.

L. Sales of Laser engines increased day by day as a result of competition success and the engines were used by more top scale modellers at the World Scale Championships.

Post Reading

I. Define the main idea of the text, make a short plan of the content.

II. a) Find the English equivalents to the following words and word combinations in the text:

Улучшенное охлождение, двигатели высшего класса, приводить к, максимальная возможность, вытянутые стальные коленные валы, день за днём, специальный зажим, с укороченным ходом, свеча зажигания, выходная мощность, впускной клапан, рычаги, новшество, первоначальный ряд, пять из 10 лучших моделей, масштабная конкуренция, конкурирующий конструктор, небольшой шумоглушитель, опытный конструктор, благодаря, зарекомендовать себя

b) Reproduce the context in which they were used.

III. Complete the following sentences using the ideas from the text.

1. The cylinder head with hardened steel rockers, valves and collets was introduced into...
2. At the World Scale Championships in Canada 5 out of the top ten models were...
3. The power and reliability of Laser engines is perfect for...

4. Nowadays laser engines dominate International and British FAI scale competitions with a unique combination of...
5. The first Laser-61 proved to be...
6. The cylinder head on the 75 and 90 was modified...
7. Only the aerobatic rules demanded...
8. Power to weight ratio was more important than...
9. ...was smaller and lighter than the existing 120 engines.

IV.a) Answer the questions.

1. What characteristics do laser engines possess nowadays?
2. What did laser engines prove to be at the World Scale Championships in Canada?
3. What are laser engines perfect for?
4. When did the first laser engine run?
5. How were Laser-75 and 120v twin developed?
6. When was a 4-stroke engine demonstrated for performance for the first time?
7. Why was power to weight ratio more important than specific power output at the Laser-150?
8. What new components were introduced in the Laser-150 single?
9. What was made standard on all engines to noise reduction?

b) Think of three more questions.

Language in Use

I. Use the prepositions in the oval to complete the sentences in the text.

as, by, at, in, to, on, with, for

Export sales of Laser engines increased ___a result of competition success and the engines were used ___more top scale modellers ___the World Scale Championships ___Deelan ___the Netherlands in 1994. The Laser-300v was introduced following development the previous year and the prototype 120 single and 240v were produced. ___further improve lubrication the second ring ___the Laser-150 and 300v was modified to make the ring an oil control ring.

This was introduced on production engines from August 1994.The short stroke 120 single was introduced ___1995. This exceptionally compact and lightweight engine ___a high power ___weight ratio is shorter than any 91 4-stroke engine and more powerful. A new carburettor ___our specification was introduced in August 1995 ___the 120, 150 and 300v engines.

II. What do the words mean in the text? Choose the correct meaning a), b), c).

1. top	a) to be better than smth else	b) the best position	c) the highest part of smth
2. powerfull	a) able to influence	b) physically strong	c) working well
3. initial	a) happening at the beginning of a process	b) the first letter of someone's name	c) to write your name in documents
4. fuel	a) petrol or diesel	b) mainly journalism	c)substance such as oil, coal, wood
5. to demonstrate	a) to protest aqainot smth with other people	b) to show clearly that smth exists	c) to show how to do smth
6. capacity	a) the amount of smth that can be put into a container	b) the amount of goods that a company can produce	c) the ability to do smth
7. commitment	a) a strong belief in smth	b) a promise to do smth	c) duty or responsibility

III. Collocate words in the table.

inlet	capaciy
tensile	engines
power	show
lifetime	ratio
uprated	modeller
weight	output
maximum	valve
short	reduction
noise	stroke
trade	steel

IV. Fill in the blanks with suitable derivatives of the words in the oval. Explain the meaning of the nouns.

to rely, to perform,
to maintain, to
adjust, to clear

4-stroke engines are very complicated. Are they difficult to use and maintain?

The 4-stroke engine is very reliable, every motor car is fitted with a 4-stroke engine, the 2-stroke cannot match the qualities of _____, _____, economy, and low cost. Although it is more complicated the parts are very reliable. The only additional _____ is the occasional _____ of the valve _____ which is not critical on the Laser engine.

V. The following suffixes are used to form different parts of speach.

Noun - **ment, ness, sion, tion, ty, al**
Adjective – **ful, ic, able, ous, y, ive, al**
Verb – **ize/ ise**

Form new words using the suffixes from the box above. One is done for you.

Noun	Verb	Adj/participle
dertermination	determine	determinated
combination	-------	combined
-------	operate	-------
-------	-------	developed
-------	complete	-------
demonstration	-------	-------
-------	perform	-------
-------	-------	considered
introduction	-------	-------
-------	-------	unlimited
-------	rely	-------
production	-------	-------
-------	-------	connective

Speaking: now you

Student A. You are a representative of the museum of engine history. Your task is to tell the visitors about the engines of new generation. Try to speak about the chronical of laser engine history.

Student B. You are one of the visitors of the museum of engine history, and you are very interested in the history of laser engines. Try to make as more questions to the guide as possible.

You may use expresions from the text .

scale competitions
competition modelles
the initial range
a maximum capacity
a lifetime modeller
demonstrated for performance
result in
the uprated engines
due to

Writing

Make a research, write about one type of laser engines you find reliable.

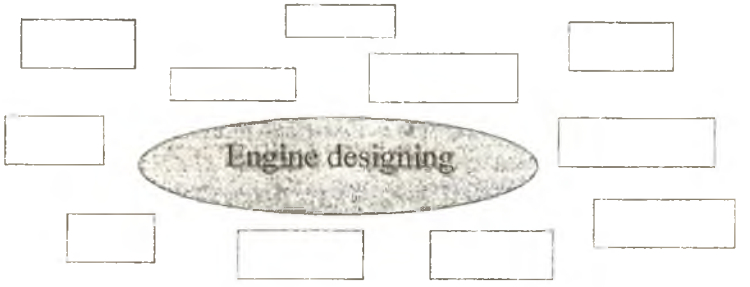
Follow the plan:
1. Date.
2. Inventor.
3. Name.
4. Characteristics.
5. Application.

Unit II

The Design of Laser Engines

Before You Begin

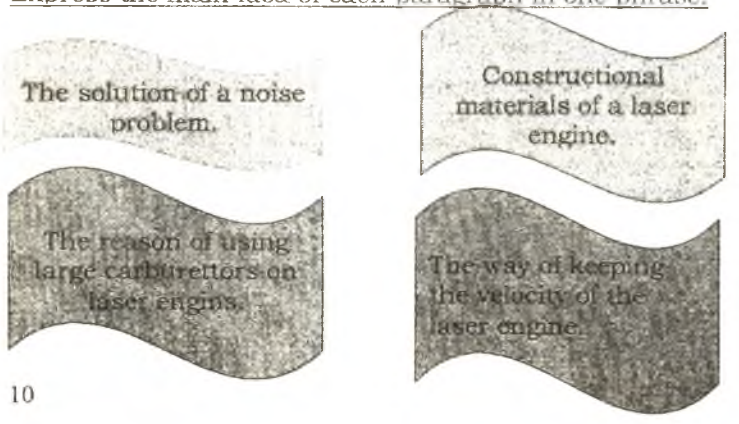
I. Look at the diagram. Fill in the words connected with the engine designing. Discuss principle parts of any engine.



II. Scan the text to find main components of a laser engine. Check if your predictions were correct. Put them down.

Reading

I. Read the extracts and choose the appropriate title for each of them. Express the main idea of each paragraph in one phrase.



The Design of Laser Engines

A. Laser engines are manufactured in England and are the only range of single cylinder and twin 4-stroke model engines manufactured in the Western World. The components used in laser engines are individually manufactured from solid metal using the latest Computer Numerically Controlled machinery. This ensures extreme accuracy and strength. The parts made from aluminium are finish turned or bead blasted externally. All the steel bearing parts are fully hardened and ground or honed to finish. Standard bearings are used which can be bought anywhere in the world.

B. The design of the Laser engine followed an intensive study of all types of full size 4-stroke engines and model engines. Since the first Laser ran in 1983 the design has been refined with continuous development. New materials, processes and machining techniques have become available and improved the engine further. For a model aircraft, the engine has to have a high power to weight ratio and be very reliable. Compact, especially from the front profile, it has to meet noise criteria which means a silencer has to be fitted. A silencer fitted externally would spoil the shape of a model so it has to fit behind the engine within the cowl. The carburettor also has to be within the cowl, again the only place is behind the engine.

C. All modern high performance engines have the carburettor in a straight line to the valve port, you can see this feature on any motor - cycle engine. Air and fuel are of different weights and if the mixture is forced round a bend, centrifugal forces affect the mixture and also reduce velocity. The carburettor on the Laser engine is fitted near the cylinder head to give a straight line to the port.

D. Silencer pressure is not needed with Laser engines. Pressure is used on many engines to increase power by increasing the size of the carburettor. Pressure reduces throttle response as pressure has to build up when the throttle is opened. It can be a source of fuel contamination as burnt oil can pass back into the silencer and adjustment to the main needle can be more critical. In the event of the pressure pipe coming off or fracturing, the engine would stop. A larger carburettor makes the needle setting more critical and reduces reliability.

Post-Reading

I. a) Find the Russian equivalents to the following words and word combinations in the text:

The only range of, individually manufactured, solid metal, Computer Numerically Controlled machinery, extreme accuracy and strength, finish turned, bead blasted, are fully hardened and ground, has been refined, to meet noise criteria, spoil the shape, within the cowl, is forced round a bend, throttle response, a source of fuel contamination, pressure pipe, fracturing

b) Reproduce the context in which they were used.

II. Complete the following sentences using the ideas from the text.

1. The components used in Laser engines are...
2. The parts made from aluminium are...
3. All the steel bearing parts are fully...
4. Since the first Laser ran in 1983 the design has been...
5. For a model aircraft, the engine has to have...
6. A silencer fitted externally would spoil...
7. The carburettor also has to be...
8. If the mixture of air and oil is forced round a bend, centrifugal forces will...
9. Pressure is used on many engines to...
10. In the event of the pressure pipe coming off or fracturing, the engine would...

III. What do the words mean in the text? Choose the correct meaning.

1. manufactured	a) to make certain
2. components	b) to affect smth in a way that makes it worse
3. to ensure	c) to suit
4. to be turned	d) to influence
5. fracturing	e) reaction
6. to be refined	f) included in a range of things
7. available	g) a part of a machine that opens and closes for controlling the air
8. to meet	h) pollution
9. a cowl	i) to be chaneged in the position
10. to spoil	j) parts
11. within	k) able to be obtained,taken, or used
12. valve port	l) breaking
13. to affect	m) a thing that covers smth
14. response	n) produced
15. contamination	o) to be changed for improving

IV. Read the text and then write questions for the answers.

1. In England and in the Western World.
2. From solid metal using the latest Computer Numerically Controlled machinery.
3. All the steel bearing parts are.
4. Since the first Laser ran in 1983.
5. New materials, processes and machining techniques.
6. A high power to weight ratio and reliability.
7. It would spoil the shape of a model.
8. Within the cowl.
9. Centrifugal forces affect the mixture and also reduce velocity.
10. To give a straight line to the port.
11. Because pressure has to build up when the throttle is opened.
12. Engine would stop.
13. A larger carburettor.

Language in Use

I. Use the prepositions in the oval to complete the sentences in the text.

in, to, for, of, in, from

4-stroke engines have been manufactured ___ well over 100 years. They are the most common ___ all internal combustion engines. Power, reliability, weight, exhaust emissions, fuel economy, noise and cost are factors ___ the design ___ an engine and only a 4-stroke engine can be designed to meet all these criteria. The engine ___ every motor car is a 4-stroke and even the small engines ___ strimmers (weed wackers) are changing ___ 2-stroke ___ 4-stroke to meet the latest noise and exhaust emission requirements.

II. Fill in the gaps with the suitable derivative of the word given in brackets. Translate the sentences. Use the suffixes below.

-ance, -al, -tion, -ness, -ty, -ive

1. Assuring the integrity of high-energy rotating parts is of utmost _____to aircraft engine manufacturers. (impotant)
2. Because of their complex shapes and material properties, some titanium components are quite difficult to inspect using _____ methods. (convention)
3. Such flaws can cause a severe _____ of fatigue life particularly when occurring on highly stressed aircraft engine parts. (to reduce)
4. Visual _____ methods rely on the operator's ability to clearly see sometimes very subtle changes in surface color or _____. (to inspect; reflective)
5. A human observer may miss positive _____ for a number of reasons, such as awkward viewing angles, poor contrast, _____ or fatigue. (to indicate; inattentive)
6. A study was conducted for MANHIRP to investigate the _____ of employing automated laser-based NDT methods to improve the NDE process for the _____ of safety-critical aircraft engine components. (feasible; to inspect)
7. The study demonstrated that high-resolution laser-based sensors can reduce operator _____ and human error by automatically scanning up to 100% of the surface and providing _____ measurements of difficult-to-inspect features such as small diameter bores. (subjective; quantity)

III. a) Form words opposite in the meaning using the prefixes in the oval. Consult the dictionary if necessary. Translate them.

- in; - im; -dis; -un

-efficiency
-important
-sophisticated
-significant
-placement

b) Use them in the sentences of your own.

IV. Three sentences have been picked up from the text. Choose from the sentences 1-4 and fill in the gaps. Mind! There is one extra sentence. Translate the text.

Laser-powered aircraft tested at Osaka Dome

An unmanned aircraft powered by a ground-based laser was demonstrated at Osaka Dome on March 7._____. The researchers expect the aircraft to be used for gathering information in the event of a disaster.

The aircraft measures 78 cm (30 in.) long, weighs 800 grams (1.8 lbs.), and has wings like a kite. A disc-shaped solar panel attached underneath powers the propeller when struck by a ground-based laser.

A battery powered the aircraft's propeller at take-off, but once it reached an altitude of about 50 meters (165 feet) — near the ceiling of the dome — the aircraft switched to laser-powered flight. The laser remained on target (error less than 1 cm) throughout the 20-minute flight around the dome. _____.

Flight time with this technology is unlimited as long as the laser can reach the aircraft, as opposed to a 5-minute flight time when powered by battery. _____. Leisure-related applications are also possible.

1. Researchers envision this type of aircraft being used to get an understanding of areas devastated by earthquake or flood, or to serve as flying communication relay stations.

2. Observers say the aircraft looked like a kite flying on a string of light.

3. The aircraft is the work of a Kinki University research team led by Professor Nobuki Kawashima (aeronautical engineering).

4. The loss of this material can affect engine performance and inspection of the bond line in production or engine overhaul is required.

Speaking

Work in pairs and discuss the benefits and drawbacks of a laser 4-stroke engine comparing it with a 4-stroke internal combustion engine.What novelties does a laser engine have? The words given below will help you.

	Laser 4-stroke Engines	4-stroke Internal Combustion Engine
Benefits		
Drawbacks		

-solid metal
-extreme accuracy and strength
-to be finish turned
-to be bead blasted externally
-to be refined
-to become available
-high power to weight ratio
-to be very reliable
-to meet noise criteria
-to fit behind
-to increase power by increasing the size
-fuel contamination

Writing

a) Research your engines on their characteristics.
b) Write the typical characteristics on the following items:

- speed
- spheres of application

Unit III
Design of Laser Engines
Part II

Before you Begin

I. Write these words in the correct group.

valve guide, accuracy, cylinder, plating, expensive, thickness, crankshaft, cowl, beam, hardened, efficient, detonation, crash, negligible, cooling fin, extra strength, rigidity, camshaft, rocker, tightened, essentially practical

construction

characteristics

II. Scan the text to find main components and characteristcs of a laser engine. Check if your predictons were correct. Put them down.

Reading

Read the text below and answer which paragraph A, B, C, D, E , F, G tells you about the following:

1.Separate valve guides.
2. Driving the pushrods and rockers.
3. Major advantages of the pushrods.
4. Efficient combustion and minimisation of detonation.
5. The 'Fail safe' system.
6. Bearing support system.
7. Providing superior cooling and far less distortion than a separate liner and fins.

A. The 'Wedge' shape combustion chamber is recognised for performance providing good air flow characteristics and large 'Squish' areas for efficient combustion and minimisation of detonation. This allows the Laser engine to run on zero or low nitromethane and have excellent fuel efficiency.

B. The valves are inclined to the rear of the engine reducing the height of the engine. Although more complicated as a separate drive has to be taken from the crankshaft, the rear pushrods have two major advantages. The maximum height of the cylinder head is further back following the profile of most aircraft cowls and there is less chance of damage in a crash.

C. Just like 'Full size' engines, the Laser engine has separate valve guides. These are longer than the combined guide and seat fitted to model engines and give greater accuracy in seating the valve. With hardened valves wear is negligible but the guides can be replaced and the valve seats can be reground.

D. Cooling fins are machined integral with the aluminium cylinder barrel giving superior cooling and far less distortion than a separate liner and fins. Nickel Silicon Carbide is electro plated directly into the aluminium. This process is similar to the plating used on Formula 1 racing engines and car manufacturers such as Porsche, BMW and Jaguar. It is very expensive and should not be compared with electroless plating used on some engines which is less than one tenth of the thickness.

E. Long beams are machined onto the crankcase for extra strength and support. The cylinder head bolts fix direct to the crankcase giving more strength and rigidity. As the engine warms up the steel bolts tighten further against the expansion of the aluminium cylinder so it is impossible for the cylinder head to come loose when the engine is running. This 'Fail safe' system is used on many full size engines, the Rolls Royce Merlin is an example.

F. A pinion drive is engaged with the crankshaft to drive the twin camshafts fitted at the rear of the engine. Flat headed cam followers are used to drive the pushrods and rockers. The camshaft profile is computer generated and like all performance engines there are two camshafts.

G. The crankshaft is made in one piece from nitride hardened high tensile steel supported in the front housing by two ball bearings. The bearings used are standard and can be obtained anywhere in the world. The propeller driver is secured with a taper collet so there cannot be any movement between the driver and the crankshaft which could loosen the propeller nut.

Post Reading

I. Match these English words with their Russian equivalents:

rigidity	клинообразная форма
loosen	взрыв
loose	клапан
taper collet	склоняться к чему-либо
camshaft	коленовал
pinion	шток
cam	обтекатель
crankcase	направляющая деталь
plated	незначительный
distortion	задняя часть; опора
cooling fin	охлаждающая пластина
barrel	вал
seat	искажение
negligible	обшитый металлическим листом
guide	картер двигателя
wedge shape	твёрдость
valve	неприкреплённый
pushrod	шестерня
crankshaft	распределительный вал
cowl	кулачок
to incline	конусная зажимная втулка
secured	укреплённый
detonation	ослаблять

II. Rearrange the words to make a meaningful sentence.

1.Allows/ engine/ efficiency/ Laser/ to/ run/ nitromethane/ and/ have/ fuel/ this/ on/ zero/ excellent/ the/ or/ low.
2. The/ separate/ guides/ Just/ engines/ has/ valve/ 'Full size'/ like/ engine/ Laser.
3. Engine/ inclined/ reducing/ the/ engine/ to/ the/ height/ valves/rear/ are/ of/ the/ of/ the.
4. Is/ the/ aluminium/ electro/ Silicon/ plated/ Nickel/ into/ Carbide/ directly.
5. Giving/ rigidity/ the /cylinder/ to/ strength/ and/ bolts/ head/ the/ direct /crankcase/ more/ fix.

III. What do the words mean in the text? Choose the correct meaning. Make up your own sentences with these words.

1. chamber	a) to be good at
2. performance	b)the shape of smth's face when you look at it from the side
3. detonation	c) to have a harmful affect on smth
4. to be inclined	d) not important
5. crankshaft	e) a change that makes smth not accurate
6. profile	f) the speed or effectiveness of a machine
7. to damage	g) explosion
8. negligible	h) an enclosed space inside a machine
9. distortion	i) a thin layer of metal that covers a metal object
10. plating	j) a long metal bar in the engine connected to the wheels and changes power into movement

IV. Answer the questions according to the text.

1. What does the "Wedge" shape combustion chamber provide for efficient combustion?
2. What allows the laser engine to run on zero or low nitromethane and have excellent fuel efficiency?
3. What is the function of the valves in the engine?
4. What provides less chance of damage in crash?
5. Why is wear negligible on valves?

6. How are cooling fins machined?
7. What process is similar to the plating used on Formula 1 racing engines?
8. What are long beams machined onto the crankcase for?
9. How do steel bolts change as the engine warms up?
10. What is used to drive the pushrods and rockers?
11. How many camshafts are there in Laser engines?
12. What is the crankshaft made of?
13. What is the propeller driver secured with?

V. Point out the main components of the laser engine. Give their characteristics.

components	characteristics

Language in Use

I. Use the prepositions in the oval to complete the sentences in the text.

for; of; out; in;
to; without; at

Laser engines are very strong and will withstand most crashes ___ damage. This makes them very suitable ___newcomers ___the hobby. The valve gear is ___ the back ___the engine ___ of the way. We carry out all our own servicing. This keeps costs low and speeds repairs. Naturally there is a guarantee for one year. ___that ___ the unlikely event ___ a part failing in normal use we would replace it free of charge or ___ a nominal cost. We have standard service schedules so you know how much the service will be.

II. Fill in the gaps with the suitable derivative of the word given in brackets. Translate the sentences. Use the suffixes below.

-ability; -tion; -less;
-est; -al; -ment

1. The way the engine is manufactured ensures that transfer of heat to the crankcase. This reduces the _____of corrosion due to _____ of water. (possible; to condensate)
2. The cylinder liner cannot rust (ржаветь), the valves are _____ steel. (stain)
3. If the engine is inverted the rocker cover will fill with oil which is ideal for _____. (to lubricate)
4. Carving a crankcase from a solid block of aluminium produces the _____and most consistent components. (strong)
5. The main spar for an airliner is machined from solid for strength and _____. (reliable)
6. Competition models do not use on board glow as there would be _____ weight of the batteries. (addition)
7. We recommend using a glass filled nylon engine mount. This absorbs some of the _____produced by the engine. (vibrate)
8. If a cowl is fitted to the model the needles must be _____from the outside as airflow through a cowl will often affect the settings of the main needles. (adjust)
9. Castor oil gives better _____ against corrosion and overheating than synthetic oil but creates carbon that can clog the exhaust ports and silencer. (to protect)
10. Castor oil produces lacquer which can make the valves stick and carbon which can cause _____. (to detonate)

III. a)Find words in the text that mean:

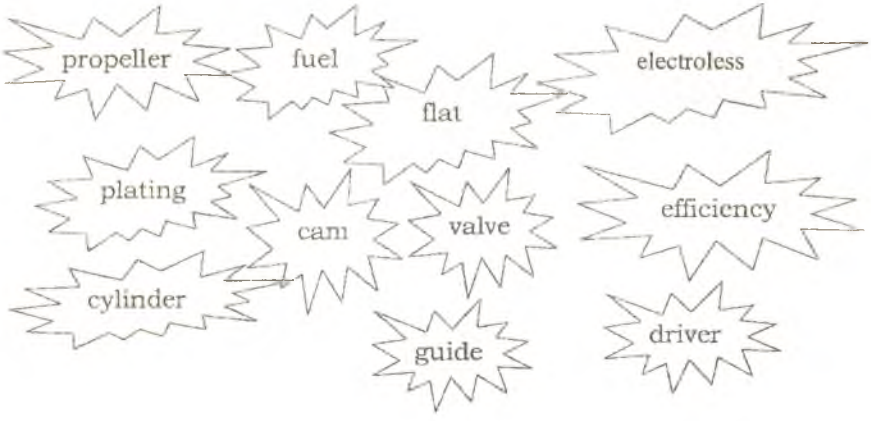
1. To pull smth until it is straighter or fits more tightly around smth (Paragraph E)
2. The ability to work well and produce good results (Pr. A)
3. The ability to do smth correct or true in every detail without making a mistake (Pr. C)
4. A high place or position (Pr. B)
5. To protect smth with a piece of metal (Pr. D)
6. To hold the weight of an object or structure so it does not move or fall (Pr. G)
7. Forming a pair of two similar things (Pr. F)

b) Choose five more words from the text and define them.
c) Reproduce all the words in the sentences of your own.

IV. Translate the following sentences. Pay special attention to the underlined words. Give your own explanation of them.

1. Ever since the dawn of powered flight, it has been necessary for all aircraft to carry onboard fuel - whether in the form of batteries, fuel, solar cells, or even a human "engine" - in order to stay aloft.
2. The team has developed and demonstrated a small-scale aircraft that flies solely by means of propulsive power delivered by an invisible, ground-based laser.
3. The laser tracks the aircraft in flight, directing its energy beam at specially designed photovoltaic cells carried onboard to power the plane's propeller.
4. The craft could keep flying as long as the energy source, in this case the laser beam, is uninterrupted.
5. This is the first time that we know of that a plane has been powered only by the energy of laser light. It really is a groundbreaking development for aviation.
6. A special panel of photovoltaic cells is designed to efficiently convert the energy from the laser wavelength into electricity to power a small electric motor that spins the propeller.
7. After the craft was released from a launching platform inside the building, the laser beam was aimed at the airplane panels, causing the propeller to spin and propel the craft around the building, lap after lap.

V. Collocate the words. Make up sentences with these collocations. Mind, there is one extra word!



Speaking

Work in groups of four. Imagine that you are at the exhibition of laser engine technology novelties. Each of you should present different components of laser engines. Use the terms and vocabulary from this unit.

-Combustion chamber
-Valves
-Valve guides
-Cooling fins
-Cylinder head bolts
-A pinion drive
-A crankshaft

Writing

Write down your own explanation of such expressions. Use the dictionary if you need.

-"Wedge" shape combustion chamber
-"Full size" engines
-"Fail safe" system

Unit IV
Lasers and Aviation Safety

Before you Begin

I. a) Guess which of these items might be mentioned in the text about laser and aviation safety:

b) Compare your list with your partner and explain the reasons why you chose these items.

II. Try to answer the following questions before you read the text.

1. What aviation hazards may lasers cause?
2. Are there any ways of eliminating hazards? What are they?

Reading

Now read the text and point out the ideas not mentioned before.

Lasers and Aviation Safety

A. Under certain conditions, laser light or other bright lights (spotlights, searchlights) directed at aircraft can be a hazard. The most likely scenario is when a bright visible laser light causes distraction or temporary

flash blindness to a pilot, during a critical phase of flight such as landing or takeoff. It is far less likely, though still possible, that a visible or invisible beam could cause permanent harm to a pilot's eyes. And, although laser weapons are under development by the military, these are so specialized, expensive and controlled that it is essentially impossible for non-military laser to cause structural damage to an aircraft.

B. Any aviation hazard from bright light can be minimized or eliminated in two ways. First, users on the ground can exercise caution, to prevent or minimize any laser or other bright light being directed in airspace and especially towards aircraft. Second, pilots should have awareness of laser aviation hazards and knowledge of basic recovery procedures in case of laser or bright light exposure.

C. It should be noted that other bright directional lights such as searchlights and spotlights can have the same dazzling – distracting – flashblinding effects. Searchlight/spotlight operators should take the same basic precautions as laser users. Similarly, pilots and safety officials should keep in mind that a reported "laser" incident may be caused by a non-laser bright light.

D. There are many valid reasons that lasers are aimed into airspace. Lasers are used in industry and research, such as in atmospheric remote sensing, and as "guide stars" in adaptive optics astronomy. Lasers and searchlights are used in entertainment; for example, in outdoor shows such as the nightly Illuminations show at Walt Disney World's EPCOT Center. Laser pointers are used by the general public; sometimes they will be accidentally or deliberately aimed at or near aircraft. (Of course, no unauthorized person should deliberately aim any type of laser at or near an aircraft.)

E. Lasers are even used, or proposed for use, with aircraft. Pilots straying into unauthorized airspace over Washington, D.C. can be warned to turn back by shining eye-safe low-power red and green laser at them. At least one system has been tested that would use lasers on final approach to help line up the pilot on the proper guideslope. NASA has tested a Helicopter Airborne Laser Positioning System.

F. Because of these varied uses, it is not practical to ban lasers from airspace. This would unduly restrict legitimate uses, it would not prevent accidental illumination incidents, and it would not stop someone who deliberately, out of malice or ignorance, targeted aircraft. For this reason, practical laser/aviation safety is based on informed users and informed pilots.

Post-Reading

I.The text has six parts A-F. What is the topic of each part? Find the key words that help to prove your point of view.

II. Say if the statements are true or false. Correct the false once.

1. Any aviation hazard can be reduced.
2. Not only lasers, but also searchlights and spotlights can cause a harm to pilot's eyes.
3. Laser pointers used by the general public are aimed at aircraft on purpose.
4. Laser pointers should be banned from airspace.
5. Aviation safety depends on informed pilots.

III. Give English equivalents to the following words and words combinations.

при определённых условиях, вызывать, приземление, взлёт, невидимый луч, находиться в стадии разработки, устранять, меры предосторожности, случайно, запрещать, предотвращать, сбиться с курса (вернуться в), закрытое воздушное пространство

IV. Answer the questions.

1. What are the conditions under which laser light or bright lights can be a hazard?
2. Are there any ways of eliminating aviation hazard? What are they?
3. Where do lasers and searchlights find their application?
4. Why is it worth using lasers with aircraft?
5. Is it practical to ban lasers from airspace? Why?

Language in Use

I. Use the prepositions in the oval to complete the sentences. Translate the sentences.

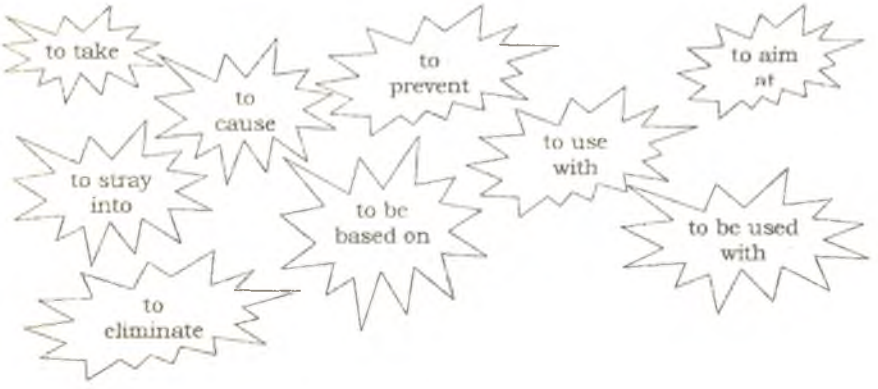
to, by, into, under, for

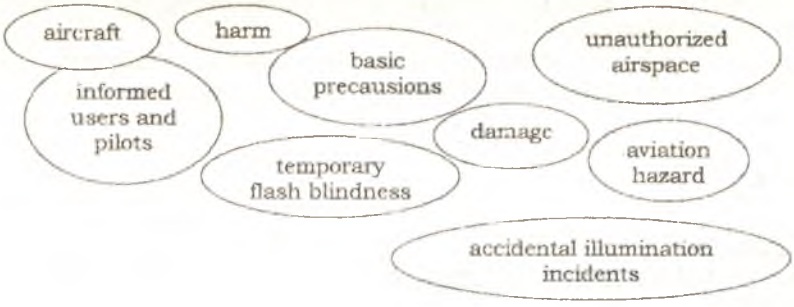
1. The so called "laser" incident may be caused _____ a non-laser bright light.
2. There are many valid reasons that lasers are aimed _____ airspace.
3. Laser weapons are still _____ development by the military.
4. It is essentially impossible _____ non-military lasers to cause structural damage to an aircraft.
5. It is possible that a visible or invisible beam could cause permanent harm _____ pilot's eyes.

II.Give the English equivalents to the words in brackets.

1. Laser users must take appropriate (меры предосторожности) to avoid accidents.
2. For example (невидимый лазер) can be an eye hazard for hundreds of feet, but presents no flash blindness, glare or distraction hazard.
3. Successful laser or aviation safety requires effort both on the ground from laser (и источников яркого света) and in the air from pilots.
4. Any person can read more about (потенциальной угрозе) in online and other sources.
5. The following three airscrew recommendations (находятся в стадии изучения).
6. A key group inside the U.S. working on (лазерной или авиационной безопасностью) is the SAE G 10-T Laser Safety Hazard Subcommittee.
7. Within the SAE G 10-T there was some consideration about cutting back or (запрещении) laser shows.

III.a) Match the verbs with the phrases below to make all possible combinations.





b) Explain them.

IV. a)Find words in the text that mean:

- serious and detailed study of a subject, that is aimed at learning new facts, scientific laws etc.
- smth likely to cause damage or loss; a danger or risk
- to stop smth happening
- the air or sky above a particular country, regarded as the property of that country
- a large light with a powerful beam which can be turned in any direction, used for looking for aircraft in the sky at night
- an action done to avoid possible danger
- to wonder away from the right or proper path or place

b) Choose 5 more words from the text and define them.
c) Reproduce all the words in the sentences of your own.

V. Translate the following sentences. Pay special attention to the underlined words. Give your own explanation of them.

1. Though it is unlikely, high power visible or invisible laser light could cause permanent eye injury.
2. In some cases this hazard may be greater since a pilot would not know they were being illuminated.
3. A dark-adapted eye is most sensitive to green light.
4. Helicopters are at great risk because they can hover, presenting a relatively stationary target.
5. A slow aircraft is at greatest risk than a fast one.
6. Here are calculations of a more powerful laser – the type that might be used in an outdoor laser show.
7. While ground-based laser hazards should be reduced as much as possible, there is always the chance of accidental exposure.

8. Terminated beams are those stopped by building, dense trees and other impermeable surfaces.
9. Targets such as bounce mirrors should have beam stop barriers around them so that if the laser misses the mirror, it does not go off into space.

Speaking

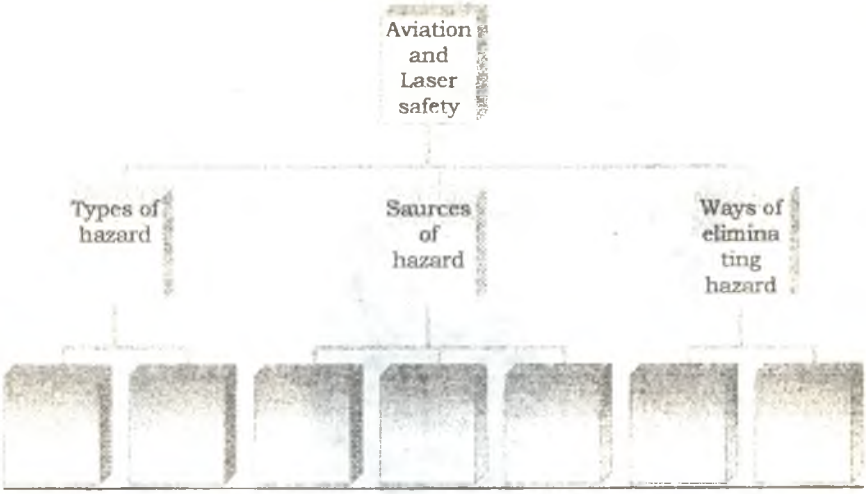
I. Work in pairs.
a) In the text find the words that mean the same as the words in box B. Fill in box A.

	A	B	C
1		to effect	_____
2		to employ	_____
3		harm	
4		accident	
5		to forbid	
6		to cut down	

b) Think of their words opposite in the meaning for lines 3-6. Fill in box C.
c) Compare your results with another pair. While discussing use the following phrases.

I strongly believe that...
As I see it...
If you ask me...
Well, I don't know, but...
I can't make up my mind, but...

II. Fill in the blankets of this graph with suitable words and speak about laser and aviation safety.



Writing

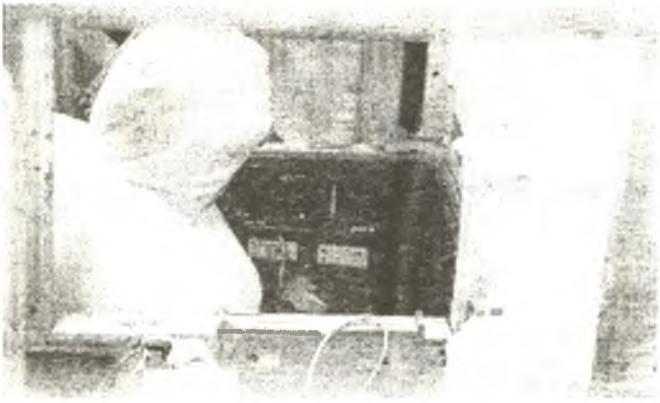
Do a research and write an essay, covering one of the topics below:

1. Laser or bright light hazard reduction.
2. Airspace free laser zones.

Unit IV
Laser Scanning

Before you Begin

I. Look at the picture and say what might be the topic of the text.



II. Try to answer the following questions:

1. What kind of device is there in the picture?
2. What is it used for?
3. Where may it find its greatest application?

III. Read this information about ablative materials and render it in Russian.

Ablative materials are fibre-reinforced organic materials used extensively to provide sacrificial cooling through progressive endothermic decomposition in liquid and solid propellant rocket engine applications. The mass flow of pyrolysis gases away from the heated surface blocks heat flux to the outer surface. The advantages of ablative cooling include simplicity, reliability, ease of fabrication, and compatibility with deep throttling requirements. Another major advantage is the elimination of the need for expensive, complex, regenerative engine cooling systems, with high pressure pumps and tanks.

Reading

Read the text and check if your predictions were correct.

Laser Scanner Cuts Time to Measure Rocket Launcher Ablative

The gas management system of a vertical launch weapon system used on surface ships is lined with ablative to protect the structure. Efforts to improve the design of the gas management system rely upon measuring the ablative material after a launch so that, for example, areas with heavy wear can be beefed up and areas with light wear can be reduced. In the past, it used to require a week using a touch probe coordinate measuring system (CMM) for an operator to measure the profile of the ablative. Recently, a defense and aerospace contractor have been switched to a laser scanning system that makes it possible to measure the ablative in only two and a half days.

The ablative protects the structure so it can be used multiple times. The wear caused by the launch leaves the ablative with a very complex geometry. Maximizing the life of the structure requires optimizing the ablative geometry so that more material can be provided in the areas that require the greatest protection. Measuring this geometry to a high level of accuracy plays a crucial role in the process of designing the ablative to obtain the maximum number of launches.

The company's engineers looked for an alternative method of the ablative. "I had been aware for some time of the development of laser scanning technology and felt that it offered significant potential for improving this application," said a Project Engineer for the company. Laser scanning systems work by projecting a line of laser light onto surfaces while cameras continuously triangulate the changing distance and profile of the laser line as it sweeps along, enabling the object to be accurately replicated. The laser probe computer translates the video image of the line into 3D coordinates, providing real time data renderings that give the operator immediate feedback on areas that might have been missed. Laser scanners are able to quickly measure large parts while generating far greater numbers of data points than probes without the need for templates or fixtures. Since there is no contact tip on a laser scanner that must physically touch the object, the problems of depressing soft objects, measuring small details, capturing complex free form surfaces are eliminated.

Instead of collecting points one by one, the laser scanner picks up tens of thousands of points every second. This means that reverse engineering of the most complicated parts can often be accomplished in an hour or two. Laser scanning can reverse engineer parts that are so complex that they would be practically impossible one point at a time. Finally, the software provided with the scanner greatly simplifies the process of moving from point cloud to computer aided design (CAD) model, making it possible in minimal time to generate a CAD Model of the scanned part that faithfully duplicates the original part. Special, but readily available software can be used to compare original design geometry to the actual physical part, generating an overall graduated color error plot that shows in a glance where and by how much, surfaces deviate from the original design. This goes far beyond the dimensional checks that can performed with touch probes on CMMs.

Post-Reading

I. The given text has four parts. Think of the title to each one. Choose the key words of each part and define the main point of it in one phrase.

II. Match parts of the sentences in columns A and B.

	A		B
1.	Maximizing the life of the structure requires	a.	the problem of measuring small details are eliminated.
2.	Since there is no contact tip on a laser scanner	b.	so it can be used many times.
3.	Efforts to improve the design of the gas management system rely upon	c.	in the process of designing the ablative to obtain the maximum number launches.
4.	The ablative protects the structure	d.	optimizing the ablative geometry.
5.	Measuring the ablative geometry to a high level of accuracy plays a crucial role	e.	to measure the profile of the ablative.
6.	In the past, it used to require a week using a touch probe CMM for an operator	f.	measuring the ablative material after a launch.

III. a) Give the Russian equivalents to the words and word combinations.

vertical launch weapon system, to measure, surface ships, complex geometry, accuracy, to line with, profile, laser scanning system, to protect, reverse engineering, touch probe, heavy wear areas, software, computer aided design

b) Reproduce the context.

IV. a) Answer the following questions.

1.What is the main function of the ablative?
2. Why is it so important to measure the ablative geometry to a high level of accuracy?
3. What was the way of measuring the profile of the ablative used in the past?
4. Do you know some new methods of measuring the profile of the ablative?
5. Which of the current methods is the most efficient one? Why?

b) Think of 3 more questions to the text.

Language in Use

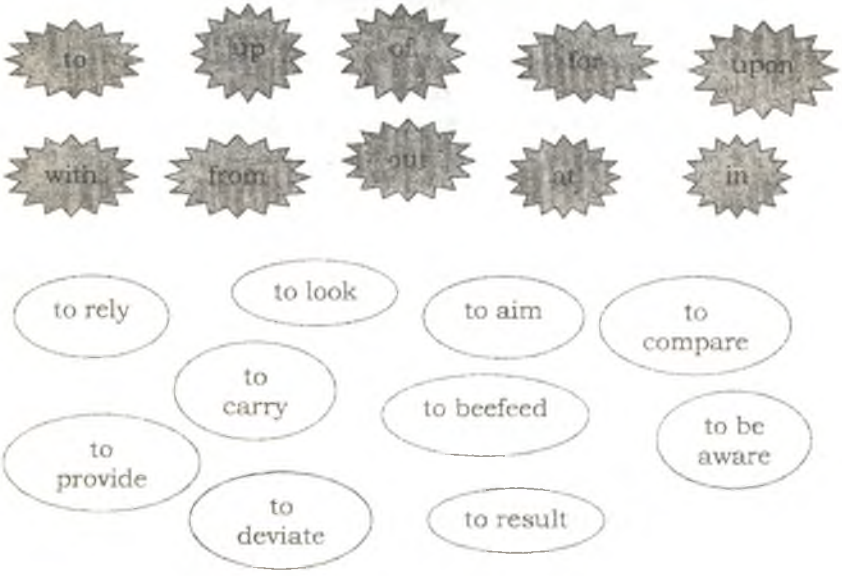
I. a) Match the words with their definitions.

1. wear	a) exactness or correctness
2. to protect	b) a side view
3. profile	c) the picture formed on the film inside a camera
4. launch	d) use which reduces, weakens or spoils the material
5. video image	e) to guard against possible future loss or damage
6. feedback	f) sending a rocket into space
7. accuracy	g) remarks about or in answer to an action or a process, passed back so that changes can be

made if necessary

b) Reproduce the context where they are used.

II. a) Find the right preposition for each verb.



b) Explain their meaning.

c) Use them in sentences of your own.

III. Translate the following sentences.

1. We can now scan the ablative and produce a surface model of its geometry in about two and a half days.

2. We can capture many times more points than it was possible in the past which improves the resolution of the final results.

3. The elimination of the need to physically touch the ablative improves accuracy, particularly in smaller cavities where it is difficult or impossible to insert a touch probe.

4. Finally, the operators' job has been made much easier because the time they need to spend and the amount of maneuvering they must perform in the confined space of the launch system has been greatly reduced.

III. Fill in the gaps using the words from the oval. Mind, there is one extra word!

to capture, to translate, advantage, to collect, accuracy, launch, to convert, wear

1. The _____ of the laser scanned surface is considerably higher because the scanner captures far more points than the touch probe.
2. In the past it took about ten days to _____ enough points than the touch probe.
3. The laser probe captures the coordinate data and an interface card _____s the video image into 3D coordinates.
4. This process _____ many more points, which increases the accuracy of the geometry, in a much shorter period of time.
5. When the _____ system is completely scanned, the operator exports the point cloud data.
6. Geomagic Studio software is used to _____ the point cloud to a surface model.
7. Sometimes engineers also use this software to compare the scanned data to the original CAD model of the ablative to quantify the exact _____ that occurred during the launch.

Speaking

I. Work in a group of three.
a) Compare the ways of measuring the ablative
- by a coordinate measuring system (CMM)
- by a laser scanning system (LSS)
on the following items:

Items	CMM	LSS
1. time used		
2. accuracy of measuring		
3. the number of surface captured points		
4. operation		
5.		

b) Think of one more item (number 5)
c) Summarise the information from the table and speak on the topic. Use the phrases below:

- The point is...
- It seems to me...
- As far as I know...
- I am sure. (I am not sure)
- I wouldn't say that...
- On the contrary...

Writing

a) In the sentences below there given some reasons of choosing SLP-330 probe by the company engineers. But the sentences are mixed. Rewrite them in a correct order.
b) Compare it with your peer.

1. The SLP-330 uses a dual detector approach that captures much more part geometry per pass, up to 50,000 points per second, than single receptor lasers.
2. A particular advantage of the SLP-330 in this application is that it can capture over a 130 degree field of view compared to a 60 degree field of view provided by most of the other probes we evaluated.
3. This probe was easy retrofitted to their existing touch probe so it helped to preserve the value of their CMM investments.
4. Another advantage of the laser probe is that dual detectors view the laser line from two different angles, reducing the number of scanning passes required to capture steep sidewalls and deep geometries.
5. They picked the SLP-330 probe from Laser Design Inc., Minneapolis, Minnesota for several reasons.
6. This makes it much easier to use the SLP-330 in the confined space of the launch because there is no need for the operator to contort his or her body in an effort to move the probe into position.
7. Company engineers looked at various laser scanning systems on the market.

Unit VI
Laser Shock Peening

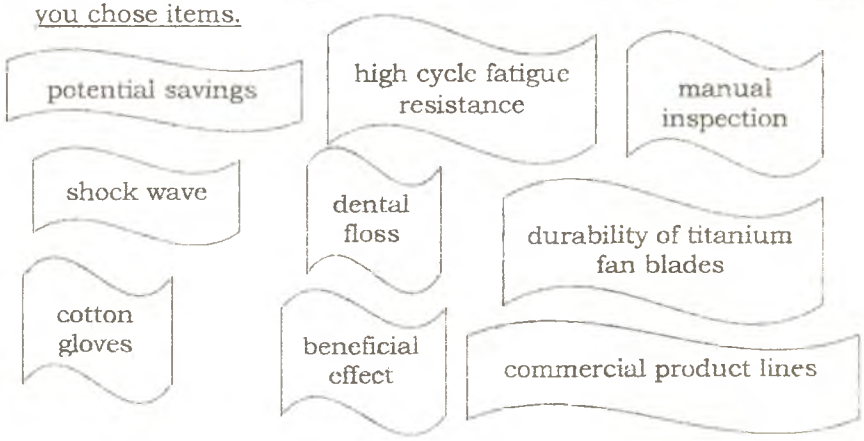
Before you Begin

I. Have you ever met the term "Peening"? Can you suggest a definition? Where may it be used?

II. Work in pairs

a) Have a look at the items below. Tick the words that might be relevant to the topic "Laser Shock Peening"

b) Compare your list with your partner and explain the reasons why you chose items.



Reading

Read the text and check whether your guesses were correct.

Laser Shock Peening. The Right Technology at the Right Time

Laser beam strikes turbine fan blade and one of the LSP RapidCenter™ robot arm

Under contract with the Air Force Research Laboratory Materials and Manufacturing Directorate (ML), a laser shock peening process is being developed which toughens damaged aircraft turbine engine blades greater than five times normal fatigue strength. Tougher engine blades result in greater resistance to foreign object damage (FOD) and less risk to aircraft and pilots.

Beginning in 1991, the F101 engine used on the B-1 began experiencing failures of titanium turbine blades due to FOD caused by ice and hard objects ingested into the engine. Chunks of blades that break loose in some cases took out the rest of the engine. Based on this, it was estimated that one to two engines would be lost per year.Two spectacular mishaps occurred in 1990, which highlighted the issue to the Secretary of the Air Force. In order to avoid grounding the B-1 fleet, the using commands required a manual inspection of all the fan blades before each flight. The time-consuming leading edge inspections involved rubbing the leading edge with cotton balls, cotton gloves and even dental floss. If a single snag was detected, the blade was replaced prior to the next sortie. In 1994, it was estimated that it took over one million man-hours to complete engine inspections and keep the B-1 flying. During that same time frame, efforts to develop a little known technology called Laser Shock Peening (LSP) were proceeding at General Electric Aircraft Engines (GEAE) under license from Battelle Memorial Institute. GEAE was investigating this new process as a potential solution to increase the durability of titanium fan blades and decrease the sensitivity to FOD.LSP uses a strong laser impulse to impart high compressive residual stresses in the surface of metal leading edge components. The laser pulse ignites a blast or shock wave from the specially coated surface of the component. The expansion of the blast wave then creates a travelling acoustic wave which is coupled into the component, thereby compressing the material lattice structure. The resulting surface compressive residual stress significantly improves the high cycle fatigue properties of the component and greatly increases resistance to blade failure caused by FOD. The high cycle fatigue results of LSP-treated blades were remarkable. A typical untreated, undamaged fan blade has a fatigue strength of 100 ksi (thousands of pounds per square inch) in high cycle fatigue testing. When a small amount of foreign object damage is present, this strength can be reduced to less than 20 ksi, which is less than half of the design requirement. However, when LSP-treated blades are comparably damaged, they still retain a fatigue strength of 100 ksi. The feasibility of LSP was thus demonstrated to be capable of restoring the structural integrity of a damaged fan blade. An engine test was conducted by GEAE with damaged LSP-treated blades and new untreated blades. The damaged LSP-treated blades performed equal to the new untreated blades. The tests demonstrated that LSP-treated blades could improve the fleet performance, if not eliminate the current FOD limitations.

Post-Reading

I. Find the description of a laser shock peening process in the text. Render it in Russian.
II. Paragraph 2 is very long. Divide it into three smaller parts. Think of the heading for each part. Choose the key words that helped you to do such division.
III. Agree or disagree with the statements. Correct the wrong ones.

1. A laser shock peening process dramatically toughens damaged aircraft turbine engine blades.
2. To avoid grounding the B-1 fleet, it was required to inspect all the fan blades after each flight.
3. Laser shock peening process was investigated by GEAE as a potential solution to increase the toughness of titanium fan blades.
4. LSP was a strong laser impulse to impart high compressive residual stresses in the surface of metal leading edge components.
5. In spite of all the improvements the damaged LSP-treated blades performance wasn't equal to the new untreated blades.

Language in Use

I. Give the Russian equivalents to the words and word combinations:

to toughen; fatigue strength; to result in; resistance; failure; to ingest; leading edge inspection; impulse; to impact; expansion; treated; performance; to eliminate

II. a) Match the words with their definitions.

1. to toughen	a) to give or pass
2. resistance	b) to cause
3. to result in	c) the non-performance of smth
4. failure	d) work
5. impulse	e) smth that was put through an industrial process and changed
6. to impart	f) to become or make tough

7. treated	g) to remove or get rid of completely
8. performance	h) a single push, or a force acting for a short time in one direction along a wire, nerve etc.
9. to eliminate	i) the started force opposed to anything moving

b)Give your own definitions for the rest of the words (Task I)
c)Use them in the sentences of your own.

III. In the following sentences all the highlighted words have an –ing-form. Do they belong to Participle I or Gerund? Give reasons to support your point of view.

1. GEAE has treated over 20,000 F101 blades and transitioned the technology for application on the F110 engine (used in F-16 aircraft), treating more than 2,000 F110 blades.
2. They are also working to apply the next generation of LSP technology to other engine components and commercial product lines in a cost-effective manner.
3. Current efforts with LSPT are focused on maturing LSP manufacturing capabilities and implementing a commercially affordable production-manufacturing cell for application to individual gas turbine engine blades.
4. LSPT is also working on reducing laser shock peening costs by increasing throughput and reducing manual labor, by automated coating and cleaning processes as well as parts handling in the cells.
5. Beginning in 1991, the F101 engine used on the B-1 began experiencing failures of titanium turbine blades due to FOD caused by ice and hard objects ingested into the engine.
6. In order to avoid grounding the B-1 fleet, the using commands required a manual inspection of all the fan blades before each flight.
7. The time-consuming leading edge inspections involved rubbing the leading edge with cotton balls, cotton gloves and even dental floss.

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

1. When these benefits will totaled, above and beyond the savings in preflight inspections and avoiding aircraft losses, this technology is resulting in a cost avoidance of over $100 million.
2. Application of these technology has avoided over $59 million in costs through reduced blade replacement costs, reduced secondary damage engine repair costs, and cost avoidance from airfoil failures.

3. By having avoided 42 catastrophic failures over the remaining life of the B-1B/F101 program, another $40 million cost avoidance would be realized.
4. The impact on the F110 has not been determined in this time, but it's projected to be at least as significant.
5. If this impact is calculated over all the engines in the Air Force fleet, the potential savings could easily approach to one billion dollars!

b) Translate the corrected sentences into Russian.

Speaking

Work in groups. Fill in the tables.
a) Group A track the chronology of the events contributed to the appearance of LSP technology.

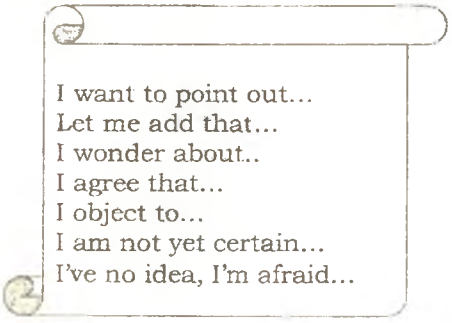
Year	Event
1990	
1991	
1994	

b) Group B fill in the table with the results of LSP-treated blades in high cycle fatigue testing.

Types of blades	Fatigue strength
1. Untreated and undamaged fan blades.	
2. Blades where a small amount of foreign object is present.	
3. Comparably damaged blades.	

c) Now share the information you've got with a peer from another group. Be ready to speak before the class on the topic.

The phrases below might be helpful.



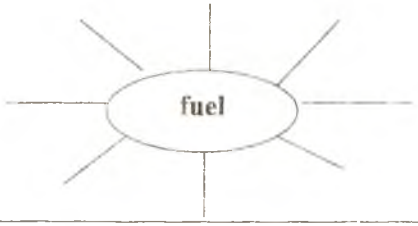
Writing

Do a research and write a short article for a school magazine on benefits and advantages of the peening technology over the previous technologies used for toughening fan blades.

Unit VII
From Gas-Powered to Laser-Powered

Before you Begin.

I. Brainstorm all possible ideas connected with different types of aircraft fuel.



II. Scan the text to find the main energy sources of the aircraft, check if your predictions were correct.
Put them down.

Reading

Read the text below and answer which paragraph A, B, C, D, E, F, G, H, I, J tells you about the following:

1. The sources of power of aircraft.
2. The designers of the first laser-powered aircraft.
3. The characteristics of the first laser-powered aircraft.
4. The test-flight of laser-powered aircraft.
5. The demonstration flights in 2002.
6. The potential commercial value of the concept.
7. The possible usage of laser-powered aircraft.

From Gas-Powered to Laser-Powered

A. Ever since the dawn of powered flight, it has been necessary for all aircraft to carry onboard fuel - whether in the form of batteries, fuel, solar cells, or even a human "engine" - in order to stay aloft.

B. But a team of researchers from NASA's Marshall Space Flight Center in Huntsville, Ala., NASA's Dryden Flight Research Center at Edwards, Calif., and the University of Alabama in Huntsville is trying to change that.

C. The team has developed and demonstrated a small-scale aircraft that flies solely by means of propulsive power delivered by an invisible, ground-based laser. The laser tracks the aircraft in flight, directing its energy beam at specially designed photovoltaic cells carried onboard to power the plane's propeller.

D. "The craft could keep flying as long as the energy source, in this case the laser beam, is uninterrupted," said Robert Burdine, Marshall's laser project manager for the test. "This is the first time that we know of that a plane has been powered only by the energy of laser light. It really is a groundbreaking development for aviation."

E. "We feel this really was a tremendous success for the project," added David Bushman, project manager for beamed power at Dryden. "We are always trying to develop new technologies that will enable new capabilities in flight, and we think this is a step in the right direction."

F. The plane, with its five-foot wingspan, weighs only 11 ounces and is constructed from balsa wood, carbon fiber tubing and is covered with Mylar film, a cellophane-like material. Designed and built at Dryden, the aircraft is a one-of-a-kind, radio-controlled model airplane. A special panel of photovoltaic cells, selected and tested by team participants at the University of Alabama in Huntsville, is designed to efficiently convert the energy from the laser wavelength into electricity to power a small electric motor that spins the propeller.

G. The lightweight, low-speed plane was flown indoors at Marshall to prevent wind and weather from affecting the test flights. After the craft was released from a launching platform inside the building, the laser beam was aimed at the airplane panels, causing the propeller to spin and propel the craft around the building, lap after lap. When the laser beam was turned off, the airplane glided to a landing.

H. The team made a similar series of demonstration flights in 2002 at Dryden, using a theatrical searchlight as a power source. The recent flights at Marshall are the first known demonstration of an aircraft flying totally powered by a ground-based laser. The demonstration is a key step toward the capability to beam power to a plane aloft.

Without the need for onboard fuel or batteries, such a plane could carry scientific or communication equipment, for instance, and stay in flight indefinitely. The concept offers potential commercial value to the remote sensing and telecommunication industries, according to Bushman.

I. "A telecommunications company could put transponders on an airplane and fly it over a city," Bushman said. "The aircraft could be used for everything from relaying cell phone calls to cable television or Internet connections."

J. Laser power beaming is a promising technology for future development of aircraft design and operations. The concept supports NASA's mission-critical goals for the development of revolutionary aerospace technologies.

Post Reading

I. Define the main idea of the text, make a short plan of the content.

II. a) Find the English equivalents to the following words and word combinations in the text:

полет с работающим двигателем; оставаться в воздухе; группа исследователей; исключительно (только) с помощью; тяга; находящийся на земле; бортовой; воздушный винт; до тех пор пока; размах крыла; единственный в своем роде; превращать энергию в электричество; летные испытания; стартовая (пусковая) платформа; виток за витком; неограниченное время (бесконечно); приемоответчик.

b) Reproduce the context in which they were used.

III. Complete the following sentences using the ideas from the text:

1. It has been necessary for all aircraft to...
2. The team of researchers has developed and demonstrated...
3. The laser-powered aircraft flies solely by means of...
4. The craft could keep flying as long as...
5. The plane weighs...
6. A special panel of photovoltaic cells is designed to...
7. ...to prevent wind and weather from affecting the test flights.
8. When the laser beam was turned off...
9. The aircraft could be used for...

IV. a) Answer the questions.

1. What is necessary for the aircraft to stay aloft?
2. Who took part in developing the first laser-powered aircraft?
3. How long can the laser-powered aircraft keep flying?
4. What was the laser-powered aircraft constructed from?
5. Where were the test flights flown?
6. Where can laser-powered aircraft be used?

b) Think of 4 more questions.

Language in Use

I. Use the prepositions in the oval to complete the sentences in the text.

to, in, with, from,
out of, at

Max Merckenschlager of Germany won the 1996 World FAI Championships held in Peregeaux, France ___ his Laser powered Albatross. Laser engines again dominated the event.
Production ___ the Laser 240v was commenced ___ 1996. This engine is exceptionally compact and has a very high power ___ weight ratio. It is designed for F3A aerobatics. Due to the very compact size, good cooling is very important to prevent overheating.
The Nickel Silicon Carbide plated cylinder was introduced to the Laser-100 and 200v in 1997.
The Laser-70 and 80 were fitted ___ the Nickel Silicon Carbide cylinder ___ 1998. Credit Card payment facilities were introduced and production increased to allow engines to be normally available ___ stock. In South Africa ___ the World Scale Championships 17 ___ 46 competitors used Laser engines and 9 ___ the first 11 placed models were laser-powered.
Laser engines powered the first three placed models ___ the 1999 European Scale championships and 14 ___ the 32 competitors used laser engines.

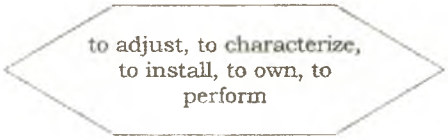
II. What do the words mean in the text? Choose the correct meaning a), b), c).

1.dawn	a) the time when the sun rises	b) the beginning of smth	c) smth. that begins to be realized
2. cell	a) a small room where a prisoner is locked up	b) a microscopic unit of living matter	c) a device for producing electric current chemically
3. to direct	a) to tell the way	b) to control or manage	c) to order
4. case	a) smth investigated by police	b) a suitcase	c) because smth. may happen
5. film	a) a motion picture	b) a very thin layer	c) a rolled strip of plastic coated, with material which is sensitive to light used for taking photographs
6. to aim	a) to point a gun	b)to throw or kick in a particular direction	c) try or intend to do smth.
7. landing	a)bringing or coming to land	b) a place where people can get on and off the board	c) the level area at the top of the stairs

III. Collocate words in the table.

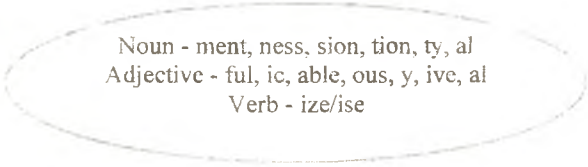
powered	plane technology
onboard	power
solar	source
propulsive	platform
energy	development
groundbreaking	participants
team	flight
low-speed	fuel
launching	cell
promising	equipment

IV. Fill in the gaps with suitable derivatives of the words given in the table. Explain the meaning of the nouns.



All laser engines are test run. Slight ___ may be necessary to suit your fuel and ___. The laser engine does have some different ___ to offer engines and the following notes, as the result of experience gained from the use of laser engines in our own models and, more important those of other laser ___. We want you to enjoy using your laser engine and ensure reliable ___.

V. The following suffixes are used to form different parts of speech.



Form new words using suffixes from the box above. One is done for you. Consult the dictionary if necessary. Translate them.

Noun	Verb	Adj/participle
determination	determine	determinated
...	power	...
...	demonstrate	...
...	propel	...
direction	...	...
...	design	...
...	interrupt	...
...	...	developed
...	...	constructed
control	...	...

...	select	...
communication	...	...
equipment	...	...
revolution	...	...

Speaking:

now you are

Student A.	Student B.
You are a designer of a laser-powered aircraft. Your task is to describe the performance of your aircraft, the principle of its operation and potential usage.	You are a representative of an aircraft-building company interested in a laser-powered aircraft. Try to make as many questions to the designer as possible.

You may use expressions from the text:

propulsive power delivered by
invisible ground-based laser
to track the aircraft,
energy beam,
to convert the energy
to propel the craft
onboard fuel
to carry equipment
telecommunication industry
transponders

Writing

Write about laser-powered aircraft.

Follow the plan:

1. Designers.
2. Characteristics.
3. Test flights.
4. Application.

Unit VIII

Laser Powered Spacecraft to Launch Microsats

Before You Begin

I.Here is the title of the text **"Laser Powered SpaceCraft to Launch Microsats".** Try to predict the topic of the text and write down 10 words, that may be related to it. Then work in pairs. Share the words and give your predictions about the content of the text.

II.Scan the text to find if your predictions were correct.

Reading

I.Read the text and write out the words and word combinations you don't know, try to guess their meaning from the context, compare your notes with your partners.

II.While reading the text define which paragraph A, B, C, D, E, F tells you about the following:

1.The designer of the laser lightweight concept.
2.The first research flights of laser-propelled aircraft.
3.Robert Goddard's rocket.
4.Description of the laser-propelled vehicle.
5.Sponsors of the Laser Propulsion Program Laser Powered Spacecraft to Launch MicroSats.
6.The reason for investigating the laser launch concept.

Laser Powered Spacecraft to Launch MicroSats (Part I)

A. Washington DC - December 14, 1997 - The futuristic concept of small laser-propelled spacecraft has taken its first research flights towards reaching space. That progress has been measured by short flights of 2-20 seconds duration at a military research facility using a high power infrared (C02) laser, a wavelength invisible to the naked eye.

B. The achievement can be likened to Robert Goddard's first successful flights of his liquic propellant chemical rocket that attained a height of 41 feet after a 2½ second burn in March of 1926. In sharp contrast with Goddard's rockets, there is absolutely no fuel or board this prototype laser-boosted craft, which has a diameter of 15 cm, mass of 40-50 grams, machined from a solid block of 6061-T6 aluminium.

C. The Air Force Research Laboratory's Propulsion Directorate at Edwards AFB CA is conducting these technology development research and flight demonstrations. Additional research money has been provided this year by NASA's Marshall Space Flight Center's (MSFC) Advanced Space Transportation Program. The laser propelled flights take place at the White Sands Missile Range (WSMR) in New Mexico at the High Energy Laser Systems Test Facility (HELSTF). The Lightcraft propulsion research employs the Pulsed Laser Vulnerability Test System (PLVTS), a 10 kilowatt laser built by AVCO TEXTRON for the Army. PLVTS is the highest average power, pulsed carbon dioxide laser presently operating in the United States.

D. The laser-propelled vehicle, called "Lightcraft" because it flies on a beam of laser light, is designed to harness the energy of a laser beam and convert it into propulsive thrust. The Lightcraft receives the kilojoule pulses from the PLVTS laser at a rate of 10 times per second upon the concentrating mirror that forms its rear section. The function of this parabolic mirror is to focus the pulsed laser energy into a ring-shaped "absorption/propulsion" chamber. Here the laser beam is concentrated to extremely high intensities, sufficient to momentarily burst the inlet air into a highly luminous plasma (10-30,000 K), with instantaneous pressures reaching tens of atmospheres providing thrust. This airbreathing pulsed detonation engine concept owes its origins to the German V1 "Buzz Bomb" of WW II that ran on aviation fuel.

E. The laser Lightcraft concept was first proposed and developed by Prof. Leik Myrabo of Rensselaer Polytechnic Institute in Troy, New York, under sponsorship of the Laser Propulsion Program of the former Strategic Defense Initiative Office (SDIO). He is now collaborating with the Air Force Research Laboratory's Propulsion Directorate at Edwards AFB CA to conduct field tests to demonstrate how the craft can be propelled using available high powered lasers. Dr. Franklin Mead of the lab's advanced propulsion group studied the initial SDIO proposal, and offered Myrabo a multi-year sabbatical position at the lab and assistance in developing and validating the concept.

F. The predominant reason for investigating this laser launch concept is its low cost, simplicity and responsiveness upon demand. Laser Lightcraft and their propulsion modes are a radical departure from the chemically fueled rockets used today. If successful, this new energy beam propulsion technology will supplement rather than replace current manned and unmanned launch systems.

Post Reading

I. Define the main idea of the text, make a short plan of the content.

II. Match the English words with their Russian counterparts.

1.duration	1. топливо
2. to the naked eye	2. невидимый
3. invisible	3. сила, напряженность
4. propellant	4. мгновенный
5. to attain	5. брать начало
6. to employ	6. происходить от
7. propulsive thrust	7. продолжительность
8. intensity	8. подтверждать
9. in contrast	9. сотрудничать
10. instantaneous	10. использовать
11. airbreathing engine	11. невооруженным глазом
12. to owe one's origin	12. достичь
13. to collaborate with	13. ВРД
14. to validate	14. тяга, как движущая сила
	15. в отличие от

III. a) Find the English equivalents to the following words and word combinations in the text:

длина волны, приравнивать, химическая ракета на жидком топливе, на борту, достичь высоты, испытательное оборудование, излучение лазера, при финансовой поддержке, проводить летные испытания, обосновать концепцию, работать на авиационном топливе, в форме кольца, имеющийся в распоряжении

b) Reproduce the context in which they were used.

IV. Complete the following sentences using the ideas from the text.

1.The laser-propelled vehicle is designed...
2.The function of the parabolic mirror is...
3.The laser beam is concentrated to...
4.The laser Lightcraft concept was first...
5.The craft can be propelled by...
6.The laser-propelled vehicle is called "Lightcraft" because...
7.The energy of a laser beam is converted into...
8. ... ran on aviation fuel.
9. ... under sponsorship of the Laser Propultion Program.

V. a) Look at the text again and answer the questions.

1. What is the difference between Robert Goddard's rocket and laser-boosted craft?
2. Why is laser-propelled vehicle called "Lightcraft"?
3. What is the function of parabolic mirror?
4. Where and by whom was the laser Lightcraft concept first proposed?

b) Think of three more questions.

Language in Use

I. Use the prepositions in the oval to complete the sentences in the text.

by, at, in, to,
within, for, of, under, at, from, into

In the last several years, lasers have become a ubiquitous part of consumer electronics. _____the last year alone, over 500 million laser devices were sold worldwide. Advancements ____technology have made a wide array___these devices available____the public___reasonable costs. Small, handheld green laser pointers, which once cost hundreds of dollars, can now be purchased for ___$50. Despite their low power and innocuous appearance, green laser pointers can produce beams several miles long and can cause serious damage___ the unprotected eye.

A rash of incidents _____the end of last year involving handheld laser pointers has fueled a growing concern _____the aviation industry. In September, a pilot ____Delta Airlines reported an eye injury ____a laser shone ____his cockpit during approach____ Salt Lake City, Utah. Last November, the FBI and Department of Homeland Security (DHS) posted a bulletin stating that terrorists may seek to down an aircraft ____shining lasers ___the cockpit to blind pilots.

II. Match the words with their definitions.

1.concept	1. careful study to discover facts or information
2. achievement	2. to control and use smth
3. prototype	3. to ask for smth firmly or forcefully
4. research	4. happening now
5. to harness	5. success in doing or producing
6. facility	6. an indication of future success or good results
7. to demand	7. an idea
8. current (adj.)	8. smth. that provides you with the means to do things
9. to supplement	9. the first model of smth. from which others are copied or developed
10. to promise	10. to add to smth

III. Collocate the words in the table.

research	contrast
sharp	fuel
available	demonstration
solid	power
flight	flight
test	facility
launch	block
average	condition
aviation	effort

IV. Fill in the blanks with suitable derivatives of the words in the table. Explain the meaning of the nouns.

to apply, to play, to consume, to print, to inform, scan

When lasers were invented in 1960, they were called " a solution looking for a problem". Since then, they have found utility in thousands of highly varied____in every section of modern society, including ____technology, science, medicine, industry ___and the military.

The first application of lasers visible in the daily lives of the general population was the supermarket barcode ____introduced in 1974. The laserdisc_____, introduced in 1978, was the first successful consumer product to include a laser, but the compact disc player was the first laser-equipped device to become truly common___in homes, beginning in 1982, followed shortly by laser___.

V. The following suffixes are used to form different parts of speech.

Noun - ment, ness, sion, tion, ty, al, er|or
Adjective - ful, ic, able, ous, y, ive, al
Verb - ize/ise, ed

Form new words using suffixes from the box above. One is done for you.

Noun	Verb	Adj/participle
determination	determine	determinated
...	achieve	...
success	...	...
...	collaborate	...
...	...	propulsive
...	conduct	...
development	...	...
...	demonstrate	...
...	...	assisted
...	convert	...
...	propose	...

Speaking

I. Work in pairs and compare the liquid propellant chemical rocket and laser-propelled spacecraft. The words given below will help you.

a beam of laser light
the energy of laser beam
to convert into propulsive thrust
to run on aviation fuel
can be likened
in sharp contrast
no fuel on board
phototype
to attain a height
successful flights

Writing

I. Rearrange the following words to form meaningful sentences. Work in pairs.

1.has/ at/the White Sands/ laser/ facility/ capability/ beam/ boost/ demonstrated.
2.The/ concept/ first/ laser/ proposed/ Lightcraft/ was/ by/ and/ Prop. Leick Myrabo/ developed.
3.Was/ Lightcraft/ as/ concept/ a single-stage to orbit/ designed/ that/ become/ spacecraft/ would/ upon/ a microsatellite/ orbit/ reaching.
4.Cost/ is/ laser/ investigating/ low/ its/ launch/ concept/ this/ for/ the reason/ predominant.

Unit IX

Laser Powered Spacecraft to Launch Microsats (continuation)

Before You Begin

I.a) Tick the words which come to your mind when you think of the sphere of Laser Powered Spacecraft:

first research flights, futuristic concept, on board, prototype, aluminium, to harness the energy, parabolic mirror, a highly luminous plasma, airbreathing, engine, validating the concept, a beam of laser light, propulsive thrust.

b) Add your own words and expressions. Make the sentences on the subject using as many words from the list as possible.

Reading

Read the text below and answer which paragraph A, B, C, D, E tells you about the following:

1.The promises of the Lightcraft concept.
2.The mode of operation of Lightcraft.
3.The flight tests of a laser-propelled vehicle.
4.On-board propellant.
5.The plans of the project team.

Laser Powered Spacecraft to Launch Microsats (Part II)

A. Myrabo's original SDIO Lightcraft concept was designed as a single-stage-to-orbit spacecraft that would become a microsatellite upon reaching orbit. The spacecraft lifts-off in a laser propelled airbreathing engine mode, and as it nears Mach 5 speed and 30 km altitude, shifts into a laser propelled rocket mode. The airbreathing engine mode would develop quasi-steady thrust by pulsing at hundreds to thousands of times a second - depending on the Mach number and altitude flown along the boost trajectory into orbit. The rocket mode would use on-board propellant, in the form of liquid hydrogen or nitrogen, to convert and expand the laser energy for propulsion once the Lightcraft had climbed above the atmosphere.

Unlike Goddard's rocket engine, no oxydizer is required. The SDIO study showed that all launch to orbital conditions for a laser propelled vehicle could be satisified by a single, high-power ground-based laser - with, or without the aid of a low altitude laser relay mirror.

B. Myrabo and Mead are the project team co-directors for this laser Lightcraft research and development effort. Five different Lightcraft designs have been flight tested using the pointing and tracking system on the PLVTS laser, run by Stephen Squires and Chris Beairsto of WSMR's Directorate of Applied Technology Test and Simulation.

C. Laser boost capability has been demonstrated at the White Sands facility with Lightcraft reaching 14 feet vertically in 2-second gyroscopically stabilized free flights, as well as 400 foot horizontal guide-wire flights lasting 10 to 20 seconds.

D. The researchers plan to increase the Lightcraft's free flight altitude in November by moving the launch stand outside Test Cell 3, where the flights will no longer be limited by lab ceiling height. The near-term goal is to reach an altitude of 1 Kilometer in the next 18 months with the PLVTS laser. To climb even higher, e.g., 10 to 100 km or near the edge of space, will require re-activation of the 150-Kw pulsed "Driver" CO2 laser, now stored in Test Cell 2 at HELSTF. Preparations are underway to enlist this powerful infrared laser that was developed at the AVCO Research Laboratory (Everett, MA) in the mid 70's - under the guidance of Dr. Arthur Kantrowitz, a long time advocate of laser propultion.

E. The approach holds great promise for reducing the launch costs of micro satellites by several orders of magnitude less than today's chemical-fueled rocket technology. The evolution of ultra-lightweight high temperature materials, dual-mode laser propulsion engines, powerful lasers, and the opportunity to change science fiction into scientific fact are the driving forces behind this joint AFRL/MSFC research effort, pursuing an innovative and promising methods for reaching space.

Post-Reading

I.a) Find the English equivalents to the following words and word combinations in the text:

приблизиться к скорости 5М, квазиустановившаяся тяга, траектория разгона, за пределами атмосферы, система наведения и сопровождения, свободный полет, пусковая установка, больше не, под руководством, сторонник лазерных двигателей, открывать большие перспективы, на несколько порядков меньше, научная фантастика, совместные усилия, перспективный способ, пилотируемый и непилотируемый.

b) Reproduce the context in which they were used.

II. Complete the following sentences using the ideas from the text.

1. The researchers plan to...
2. ... the great promise for reducing the launch cost.
3. ... has been demonstrated at the White Sands facility.
4. The original Lightcraft concept was designed as...
5. ... no oxidizer is required.
6. The airbreathing engine mode would...
7. The rocket mode would...

III. a) Answer the questions:

1. What was the original Lightcraft concept?
2. How would the airbreathing engine mode develop quasi-steady thrust?
3. In what form is the on-board propellant used?
4. What differs Lightcraft engine from Goddard's rocket engine?
5. Where was the laser boost capability demonstrated?
6. What is the near-team goal of the researches?
7. What are the advantages of laser powered launch of microsats?

b)Think of three more questions.

IV.Render the main idea of the text in Russian.

Language in Use

I. Use the prepositions in the oval to complete the sentences in the text.

to, over. from, away, in,
under, of

A laser is a highly collimated source _____intense electromagnetic energy. Unlike regular light, laser light waves are all the same wavelength and run parallel ___ each other. This allows laser light to retain its power ___ greater distances. Compare a 60-watt light bulb a 5-milliwatt laser pointer. The light emanating ____ the light bulb is strongest_____ the energy source, the filament. However, just a few inches___ from the filament, the light has lost most of its intensity, ___ contrast, the laser pointer, which produces 1/120th of the light energy the bulb, can shoot a visible beam as long as 5 miles_____ideal conditions.

II. What do the words mean in the text? Choose the correct meaning a), b), c).

1.original	a) existing from the start, earliest	b) new in its design, not a copy	c) producing new ideas, inventions
2. mode	a) the way a thing is done	b) what is fashionable	
3. launch	a)start into action	b) send a rocket into space	c) set a thing moving by pushing it
4. run	a) go or travel	b) move with quick steps	c) work or function
5. ceiling	a) the flat surface under the top of the room	b) the highest limit that smth. can reach	
6. current	a) water or air moving in one direction	b)the flow of electricity along a wire	c) happening now, used now
7. order	a) a command	b) the way things are arranged	c) to a great extent
8. goal	a) the place where a ball must go to score a point in football	b) a point scored in this way	c) smth. that you are trying to reach or achieve

III. Collocate the words in the table.

original	mode
airbreathing	laser
rocket	altitude
boost	concept
ground-based	reason
test	promise
flight	engine
predominant	fiction
great	facility
science	trajectory

IV. Fill in the blanks with suitable derivativs of verbs given in the brackets.

1. Lightcraft is a radical___ (depart) from the chemically fueled rockets used today.

2. This powerful infrared laser was developed under the ___ (guide) of Dr.Arthur Kantrowitz.

3. The rocket mode would use on-board propellant to convert the laser energy for ___ (propel).

4. (prepare) ___ are underway to increase the free light altitude

5. Myrobo and Mead are the co-directors for this Lightcraft research and ___ (develop) efforts.

V. In the text, find the words with the meaning opposite to the following words:

(A) multiple, solid
(B) similar, theoretic, stagnation
(C) horizontally
(D) to decrease, inside, unlimited

Speaking

Work in pairs and discuss the original SDIO Lightcraft concept. What promises does it hold? The words given below will help you.

single stage spacecraft
upon reaching orbit
airbreathing engine mode
Mach number
altitude of 30 km
to use on-board propellant
to convert the laser energy
to satisfy all conditions
low cost
simplicity
responsiveness upon demand

Writing

I.Summarize the information given in the text "Laser Powered Spacecraft to Launch MicroSats". Use the key patterns.

the article deals with...
much attention is given to...
...is spoken about in detail
a mention should be made...
the text gives a valuable information on...