Б А К А Л А В Р И А Т

Е.Ю. Лаптева

АНГЛИЙСКИЙ ЯЗЫК
для технических направлений

Рекомендовано ФГБОУ ВПО
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в качестве **учебного пособия** для студентов вузов,
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Цель курса — формирование коммуникативной компетентности студентов технических специальностей в сфере профессиональной деятельности, а также базовых знаний об особенностях будущей профессии посредством английского языка. Основной задачей, решаемой в ходе изучения предлагаемого материала, является формирование навыка употребления профессионально значимой лексики адекватно ситуации речевого общения. Особенностями курса являются его гибкость, вариативность и заложенный в основу дифференцированный подход к обучению, что позволяет решать поставленные задачи в рамках одной группы студентов с разной подготовкой и мотивацией.

Каждый модуль включает в себя задания по анализу аудио- и видеороликов, которые собраны на сайте http://www.englishtech.ru, разработанном специально для данного пособия. Курс построен на аутентичном материале, его изучение требует наличия базовых знаний английского языка.

Соответствует Федеральному государственному образовательному стандарту высшего профессионального образования третьего поколения.

Для студентов и аспирантов технических специальностей. Может быть использовано лицами с техническим образованием, желающими самостоятельно совершенствовать свои навыки владения английским языком.

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Лаптева Елена Юрьевна

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Introduction
(Введение)

Научно-методическое обоснование

Разработка любого курса обучения иностранным языкам требует определенного подхода. Это обусловлено спецификой основной цели изучения языка — формирования коммуникативной компетентности. Эта компетентность предполагает формирование навыков в четырех видах речевой деятельности, два из которых — чтение и аудирование — являются рецептивными видами и два — письмо и говорение — продуктивными видами. При этом аспекты языка (фонетика, морфология, лексика и грамматика) оказываются органично интегрированными в формирование вышеуказанных навыков.

Приступая к разработке курса по английскому языку для студентов технических специальностей, мы руководствовались в первую очередь тем, что в технических вузах английский язык не является профилирующим предметом, что сказывается и на уровне начальной подготовки студентов, и, как правило, на невысоком уровне их мотивации. Поэтому было принято решение создать относительно универсальный образовательный контент, который представлял бы собой обобщенный материал (general topics) по профессиональной тематике; был ориентирован на несколько уровней сложности (исходя из начального уровня подготовки и различной степени мотивации студентов); мог быть адаптирован к требованиям конкретной группы студентов и дополнен (сокращен) преподавателями по мере необходимости. Другими словами, данный курс английского языка представляет собой гибко структурированный ресурс материалов для пользования как студентами (очного, заочного отделений), так и преподавателями.

Согласно российскому образовательному стандарту, который сегодня в полном объеме отражен в формате школьного выпускного экзамена по иностранным языкам (ЕГЭ), выпускники средних школ должны иметь сформированный уровень коммуникативной компетенции, соответствующий уровню Pre-Intermediate (по общепринятой международной шкале уровней владения английским языком). Таким образом, следуя принципу преемственности обучения в системе «школа—вуз», данный уровень был принят за базовый при разработке курса. Другими словами, студент обязан иметь определенный уровень знаний, умений и навыков пользования английским языком, позволяющий относительно самостоятельно ориентироваться в предлагаемом к изучению материале.

Учитывая специфику технического вуза, основной акцент сделан на формировании навыка пользования языком в рамках профессиональной ситуации общения. При проектировании курса особое внимание уделялось разработке и созданию различного рода заданий (от простого — чтение и понимание текста — до сложного — выполнение заданий на основе просмотра видеоролика), способствующих формированию навыка пользования языком. Основными же задачами курса стало формирование навыков:

- понимания общего смысла прочитанного (услышанного на более сложном уровне) без детального перевода;
- пользования толковым словарем;
- выражения своих мыслей посредством доступных языковых средств;
- самостоятельного поиска и обработки необходимой информации.

Решение этих задач предполагает, что в ходе изучения предлагаемого материала студенты, во-первых, получат базовые знания о специфике будущей профессии и, во-вторых, освоят определенный объем профессионально значимой лексики и научатся использовать ее адекватно ситуации речевого общения. Учитывая все специфические моменты и условия разработки курса, внимание акцентируется на формировании лексического запаса (если говорить об аспектах языка) и на формировании навыков чтения и аудирования (если говорить о видах речевой деятельности).

Тематика предлагаемых материалов находится в рамках основных существующих технических специальностей. Языковой материал профессионально ориентирован. За основу курса взят УМК издательства Оксфордского университета Engineering. Workshop (автор White L., OUP, 2003; уровень Pre-Intermediate). Дополнительными источниками при составлении материалов курса являлись толковые словари английского языка, справочная литература по английскому языку (см. Список использованной литературы), а также интернет-ресурсы Wikipedia и YouTube. Таким образом, материал, предлагаемый к изучению, строго аутентичен (хотя в некоторых случаях и адаптирован под требуемый уровень).

Большая просьба: при возникновении любого рода вопросов по материалам данного учебного пособия, а также при обнаружении в процессе работы каких-либо опечаток, неточностей или несоответствий обращаться по адресу lapteva.kai@mail.ru.

С уважением и наилучшими пожеланиями,
Елена Юрьевна Лаптева

The content of the course
(Содержание курса)

Цель — формирование:

— коммуникативной компетентности студентов технических специальностей в сфере профессиональной деятельности;

— базовых знаний об особенностях будущей профессии посредством английского языка.

Задачи — формирование навыков:

— понимания общего смысла прочитанного без детального перевода (услышанного на более сложном уровне);

— пользования толковым словарем;

— выражения своих мыслей посредством доступных языковых средств;

— самостоятельного поиска и обработки необходимой информации).

Базовый уровень сложности — Pre-Intermediate.

Объем курса — 340 часов аудиторной и самостоятельной работы студентов по изучению предлагаемого материала.

Тематика курса:

“Engineering in our life”, “Types of engineering”, “Making the right choice”, “Materials and their properties”, “Smart materials”, “Technical drawing”, “Industrial production”, “Electrical equipment”, “Safety equipment”, “Professional diseases”, “Optical fibres”, “Tunnels, dams, and canals (channels)”, “Scientific inventions”, “Robots in our life”, “Gadgets”, “Bridges”, “Ancient structures”, “Numbers”, “Signs, symbols, and abbreviations”, “Job application and CV”. Всего 20 тем.

Каждая тема представляет собой один модуль, в рамках которого присутствуют три уровня сложности. Структура каждого модуля выглядит следующим образом:

I. Часть I (**Part I**), первый уровень сложности:

— базовый аутентичный материал УМК OUP “Engineering. Workshop”, автор Lindsay White, OUP, 2003; уровень Pre-Intermediate (текст, базовые упражнения);

— дополнительные упражнения на закрепление изучаемого материала (на перевод, на понимание, на сопоставление фактов); различные языковые игры на основе изучаемого лексического материала («домино», «змейка», «сетка», «кроссворд» и др.).

II. Часть II (**Part II**), второй уровень сложности: аутентичный материал по изучаемой теме из интернет-источника *Wikipedia* и задания к нему.

III. Часть III (**Part III**), третий уровень сложности: видеоролики по изучаемой теме из интернет-источника *YouTube* и задания к нему.

Тестовые материалы для промежуточного контроля и **методика их оценивания**. Несколько модулей объединены одним тестом; всего тестов три. Темы “Numbers”, “Signs, symbols, and abbreviations”, “Job application and CV” не включены в тесты, так как представлены для ознакомительного изучения.

Test 1 — модули 1–5.

Test 2 — модули 6–10.

Test 3 — модули 11–17.

Максимальное количество баллов в каждом тесте — 100.

51–70 % (51 — 70 баллов) — «3».

71–85 % (71 — 85 баллов) — «4».

86–100 % (86 — 100 баллов) — «5».

Экзаменационные материалы для итогового контроля и **методика их оценивания**:

10 экзаменационных билетов.

Письменная и устная части.

Письменная часть экзамена — пять заданий на подстановку, замещение, сопоставление, объяснение, понимание.

Устная часть экзамена — тема для беседы с преподавателем.

Максимальное количество баллов за экзамен — 50 (40 баллов — за письменную часть, 10 баллов за устную).

51–70 % (25,5 — 35 баллов) — «3».

71–85 % (35,5 — 42,5 баллов) — «4».

86–100 % (43 — 50 баллов) — «5».

Приложение. Курс включает в себя список активной лексики по каждой теме (Active Vocabulary); словарь для изучения материала первой части (Glossary); грамматический справочник (Grammar Reference); дополнительные тексты для чтения (Additional Texts for Reading) и видеоролики для просмотра (Additional Video); различного рода ссылки на дополнительную литературу и на образовательные интернет-сайты (Internet References).

Instructions
(Методические рекомендации)

Приступая к занятиям по английскому языку по данному курсу обучения, следует придерживаться следующих рекомендаций.

Любая деятельность должна представлять собой определенную систему. Таким образом, изучение материала данного курса также должно носить системный, систематический характер.

Курс представляет собой упорядоченную систему. Рекомендуется последовательное изучение модулей (тем) курса (с 1 по 17). Возможно (на усмотрение преподавателя) первоочередное прохождение модулей 18, 19, 20, содержащих важный, но дополнительный материал (цифры, числа, разного рода символы, аббревиатуры и т.п.).

Курс разработан с использованием основных дидактических принципов обучения, одним из которых является расположение материала от простого к сложному. Поэтому рекомендуется последовательное выполнение как частей I, II и III в рамках одного модуля, так и заданий в рамках каждой части.

В целях осуществления своевременного контроля за процессом изучения материала рекомендуется выполнение предлагаемых тестов после модулей 5, 10 и 17 соответственно. Формат заданий, предлагаемых в тестах и на экзамене, соответствует формату заданий, предназначенных для усвоения материала в ходе прохождения данного курса.

В процессе изучения модулей курса и по его окончании рекомендуется обращаться к предлагаемому списку активной лексики для самопроверки знания требуемого на экзамене лексического минимума.

В целях развития навыка беспереводного понимания иностранного текста следует уделять большое внимание работе с толковым словарем (для части I); работе с любым толковым словарем, в том числе технического направления (для частей II и III).

В целях саморазвития и самосовершенствования рекомендуется обращаться к предлагаемым в рамках данного курса дополнительным источникам и ресурсам, списки которых находятся в конце пособия.

Приступая к работе, всегда помните, что

I hear and I forget,
I see and I remember,
I do and I understand.

A Chinese saying

1. ENGINEERING IN OUR LIFE

Part I

1. Match the following words (1—3) and their definitions (a—c).

A Practical application of scientific knowledge in the design, construction and control of machines.

B A machine with moving parts that produces energy (heat, electricity).

C A person who designs, builds, maintains engines, bridges, buildings, etc.

1 engine	
2 engineer	
3 engineering	

2. Translate the following sentences into Russian.

1. This car has got a new engine.
2. This bridge is the best example of modern engineering.
3. She's studying engineering at the University.
4. He got an engineering degree last year.
5. There are three main areas in engineering.
6. This is the best engineer in this field.
7. These students are going to become engineers.
8. Something has happened to the engine—it's not working.

3. Read the following headlines (A—D). What do you think each paragraph will be about?

A. Engineers use a method.
B. Anyone can use engineering ideas.
C. Engineering is everywhere.
D. Engineering is both theoretical and practical.

4. Read the following text and match the headings (A—D) from Ex. 3 with its parts (1—4):

1. ____________________

Almost everything we use in modern life is made by engineers. For example, if **a manufacturer** wants a faster car, a smaller personal stereo, or a better pen, they will ask a design engineer to find a practical **solution**.

2. ____________________

Engineers use theory (ideas about engineering) to produce practical answers. The design solution must be a reasonable price, safe, and reliable. A new idea that is **expensive**, dangerous, or doesn't always work is not a good solution.

3. ____________________

Generally, engineers solve problems in a **methodical** way. Engineers:

— **define** the problem;
— **design** a solution;
— test the solution;
— **evaluate** the solution. If the solution isn't right, the process is repeated. When a good solution is found, the next step is to:
— communicate the solution.

4. ____________________

This method of problem-solving is useful in **everyday** life. For example, you can use the five steps next time you prepare for a test.

1. Define the problem: I want to pass my test next week.
2. Design a solution: I will study for three hours a day.
3. Test the solution: Study for three hours a day and take the test.

4. Evaluate the solution: Have I passed the test with a good mark? Yes = a good solution. No = a bad solution, so think of a better one.
5. Communicate the solution: Tell your friends about your test-passing technique.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 1*, *pg. 2*, *Ex. 3.*)

5. Read the text again and decide if the sentences (1–4) are true (T) or false (F).

1	Lots of things are made by engineers.	T	F
2	Engineering isn’t practical.	T	F
3	Engineers must think carefully.	T	F
4	Only engineers can solve problems.	T	F

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 1*, *pg. 2*, *Ex. 4.*)

6. Read the text again and match the words in bold type with their meanings (1—8).

1	plan	
2	cost much money	
3	a business	
4	answer	
5	careful, step-by-step	
6	assess the success of	
7	normal	
8	say exactly	

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 1*, *pg. 2*, *Ex. 5.*)

7. Read the text again and find the English equivalents to the following expressions.

• современная жизнь • найти практическое решение • конкретные (практические) решения • разумная стоимость • неверное решение • решать проблемы • определить проблему • разработать решение • провести испытание • оценить результат • следующий шаг к • повседневная жизнь

8. Match the following words.

• the solution • engineers • solution • carefully • way • problems • technique • price • the problem • a solution • life • a method

1	a practical		7	think	
2	methodical		8	solve	
3	define		9	everyday	
4	design		10	test-passing	
5	reasonable		11	evaluate	
6	made by		12	use	

9. Match the words with their definitions.

• engineering • solution • to manufacture • engineer • to communicate • methodical • engine • to evaluate • to design

1	A well-organized and careful way of doing something.	
2	A person who designs, builds, maintains engines, bridges, buildings, etc.	
3	To study the facts and then form an opinion about something.	
4	A way of finding the answer to a problem or dealing with difficult situation.	
5	To be in contact with somebody by using different methods of sending information (telephone, radio, voice, gestures, body language, etc.).	
6	A machine with moving parts that produces energy (heat, electricity).	
7	To invent, plan and develop something for a particular purpose.	
8	To make something in large quantities using machines.	
9	Practical application of scientific knowledge in the design, construction and control of machines.	

10. Find the five steps of the process of solving problems. The words may be written horizontally, vertically, diagonally.

	a	b	c	d	e	f	g	h	i	j	k
1	A	W	E	R	T	Y	U	I	O	P	L
2	V	D	E	F	I	N	E	W	D	O	K
3	B	E	S	A	R	V	V	D	E	P	J
4	N	S	D	R	T	B	A	F	G	W	H
5	M	I	F	U	Y	N	L	J	H	T	G
6	T	G	G	V	U	M	U	S	S	Q	F
7	R	N	H	I	I	X	A	E	J	D	D
8	E	K	J	T	O	Z	T	A	O	Y	S
9	W	Q	M	N	B	V	E	C	X	Z	A
10	C	O	M	M	U	N	I	C	A	T	E

11. Order the following steps of solving problems:

— evaluate the solution;
— define the problem;
— communicate the solution;
— design a solution;
— test the solution.

What do we call this way of solving problems?

12. Translate the following sentences into Russian. Translate the idea, not word for word.

1. These goods are made at our manufacture.
2. Where is the manufacture situated?
3. We don’t like the quality of these goods, send them back to the manufacturer.
4. The case is very important for us, so we should find a practical solution immediately.
5. Was it difficult to find a good solution?
6. This good is a reasonable price and quality.
7. Your practical solution is quite reasonable.
8. You have designed a reasonable solution.
9. Engineers solve problems in a methodical way.

10. This means there are several steps in the problem-solving process.
11. At first you should clearly define a problem.
12. It's not sometimes easy to define a problem.
13. Different people design different solutions to one and the same problem.
14. Are you sure we should test the solution?
15. The solution was tested and turned to be a bad one.
16. I don't like the way you evaluate the situation.
17. You should be more careful when you try to evaluate something.
18. These goods were produced with the help of modern techniques.
19. The problem-solving process technique includes five steps.
20. You need to check up the engine.

13. Read the following text and fill in the gaps with suitable words.

WHAT IS ENGINEERING?

Practically everything we use in our modern life is made by (*1*) ____________. If a (*2*) ____________ wants to upgrade something, they ask a designer (*3*) ____________ to find a (*4*) ___________ solution.

(*5*) ___________ is both (*6*) ___________ and (*7*) ___________. Scientific knowledge is used to (*8*) ___________ practical answers. A good design solution must be a (*9*) ___________ price, not dangerous and reliable. Usually problems are solved in a (*10*) ___________ way. There are five steps in this process-passing (*11*) ___________:

—(*12*) ___________ the problem;
—(*13*) ___________ a solution;
—(*14*) ___________ the solution;
—(*15*) ___________ the solution;
—(*16*) ___________ the solution.

This method is very useful and can be used in our (*17*) ___________ life.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. HISTORY OF ENGINEERING

Read the text and decide if the sentences (1—5) are true (T) or false (F).

1	The invention of a wheel is an example of ancient engineering.	T	F
2	The words "engine" and "engineer" appeared at one and the same time.	T	F
3	The word "engineer" has a military origin.	T	F
4	Engineering and science are two terms (= words) for one and the same thing.	T	F
5	Nowadays engineering is everywhere.		

The *concept* of engineering has existed since ancient times as humans thought up fundamental inventions such as a wheel. Each of these inventions is consistent with the modern definition of engineering, exploiting basic mechanical principles to develop useful tools and objects.

The term *engineering* itself has a much more recent etymology, deriving from the word *engineer*, which itself dates back to 1325, when an *engineer* (literally, one who operates an *engine*) originally referred to "a constructor of military engines". The word "engine" itself is of even older origin, deriving from the Latin "*ingenium*" (c. 1250), meaning "innate quality, especially mental power, hence a clever invention".

Nowadays engineering is a large field which deals with problem-solving process for the good of mankind. It is closely connected with the science, but it's not the same. It is in close interaction with such disciplines as medicine, biology, art, computing and many other social areas of life.

2. WHAT IS ENGINEERING?

Read the text and fill in the gaps with the following words.

• engineering • engineer • mathematical
• design • discipline

Engineering is the (*1*) __________, art and profession of using technical, scientific, and (*2*) __________ knowledge to design and put into practice materials, structures, machines, devices, systems, and processes that safely realize a desired objective or invention.

The American Engineers' Council for Professional Development (ECPD) has defined (*3*) __________ as follows: "The creative application of scientific principles to (*4*) __________ or develop structures, machines, apparatus, or manufacturing processes and to forecast their behavior under specific operating conditions."

One who practices engineering is called an (*5*) __________. Engineers may have more formal designations such as Professional Engineer, Chartered Engineer, Incorporated Engineer, or European Engineer. The broad discipline of engineering includes a range of more specialized sub-disciplines. Each of these sub-disciplines has a more specific emphasis on certain fields of application and particular areas of technology.

• knowledge • serviceability • mathematics
• produce • design • solutions

Engineers apply the sciences of physics and (*6*) __________ to find suitable (*7*) __________ to problems or to make improvements to the status quo. More than ever, engineers are now required to have (*8*) __________ of different relevant sciences for their design projects, as a result, they have to keep on learning new material throughout their career.

If multiple options exist, engineers think of different design choices and their advantages (or pluses) and choose the solution that best matches the requirements. The most important and unique task of the engineer is to identify, understand, and forecast the possible future result of a design in order to (*9*) __________ a successful product. It is usually not enough to build a technically successful product; it must also meet further requirements.

Engineers should foresee different available resources, physical, imaginative or technical limitations, flexibility for future modifications and additions, and other factors, such as requirements for cost, safety, marketability, productibility, and (*10*) __________. By understanding these factors, engineers (*11*) __________ specifications for the limits within which a successful system may be produced and operated.

Answer the following questions about the text.

1. What is engineering?
2. What does the word "engineer" mean?
3. Why do engineers have to keep on learning all their lives?
4. What is important in engineering in order to produce a successful product?

3. PROBLEM-SOLVING PROCESS

Read the text and fill in the gaps with the following words:

• discipline • Testing • solutions • knowledge
• evaluate • find • known

Engineers use their (*1*) __________ of science, mathematics, and appropriate experience to (*2*) __________ suitable solutions to a problem. Engineering is considered a branch of applied mathematics and science. Creating an appropriate mathematical model of a problem allows them to analyze it (sometimes definitively), and to test potential (*3*) __________.

Usually there may be several reasonable solutions, so engineers must (*4*) __________ the different design choices on their merits and choose the solution that best meets their requirements.

Engineers typically attempt to predict how well their designs will perform to their specifications prior to full-scale production. They use, among other things, prototypes, scale models, simulations, destructive tests, nondestructive tests, and stress tests. (*5*) __________ ensures that products will perform as expected.

Engineers as professionals take seriously their responsibility to produce designs that will perform as expected and will not cause unintended harm to the public at large. Engineers typically include a factor of safety in their designs to reduce the risk of unexpected failure. However, the greater the safety factor, the less efficient the design may be.

The study of failed products is (*6*) __________ as forensic engineering, and can help the product designer in evaluating his or her design in the light of real conditions. This (*7*) ___________ is of greatest value after disasters, such as bridge collapses, when careful analysis is needed to establish the cause or causes of the failure.

Answer the following questions about the text.

1. What should an engineer do if there are many possible solutions for a problem?
2. How can possible solutions be evaluated?
3. Why is testing so important?
4. Does the high degree of safety always mean the efficiency of the design?

Part III

(режим доступа для просмотра видеороликов http://englishtech.ru/video/modul_1/)

1. BEING AN ENGINEER (01:02)

Pre-listening

1. *How can you characterize an engineer? What kind of person is an engineer?*
2. *Study the following words and phrases.*
   To disassemble, to take things apart, components, to run a test, vision, inaptitude, to lead a normal life.

While-listening

Watch **the whole video track** and answer the following questions.

3. *What kind of video is this?*
   — a documentary;
   — a comedy;
   — a humoristic cartoon.
4. *Why did they come to the doctor?*
5. *Was the result of the visit good? Why do you think so?*

Watch **the parts** of the video and answer the following questions.

00:00—00:24

6. *What did the child do yesterday?*
7. *How long did it take the child to do this?*

00:25—00:41

8. *What happened to the diagnostic machine?*
9. *Was the doctor satisfied with this?*

00:42—end

10. *What was the doctor's diagnosis?*

Watch the whole video again.

11. *Fill in the gaps in the following text.*

— I'm worried about this little Dilbert. He's not like other kids.
— What do you mean?
— (*1*) ___________ I left him alone for a (*2*) ___________ and he disassembled the (*3*) ___________, our clock and the stereo.
— That is perfectly (*4*) ___________. Kids take things apart.
— The part that worries me is that he used the components to build a home radio set.
— Oh, dear ...
— Is that (*5*) ___________?
— Normally I'd run an EEG ... mmm ... but machine is not (*6*) ___________.

....

— It's ...
— What is it?
— I'm afraid your (*7*) __________ has the "mark".
— The "mark"?
— The "mark"—it's a rare condition characterized by an extremity vision about all things, mechanical and (*8*) ___________, and other social inaptitude.
— Can he lead a normal (*9*) ___________?
— No. He'll be an (*10*) ___________.

Post-listening

12. *What is the general idea of the track?*
13. *What do you think about this?*

2. WHAT IS ENGINEERING?
(02:37)

Pre-listening

1. *What do engineers do in their profession? Use verbs to answer. For example: design, invent, etc.*
2. *What spheres of life do engineers deal with? Make a list.*
3. *What can a career in engineering provide a person with?*

While-listening

Watch the parts of the video track, do the following assignments, and answer the following questions.

00:00—01:50

4. *Order the spheres of life that engineers deal with which appear in the track.*
5. *Compare it to your own list. What didn't you mention? What wasn't mentioned in the track?*

01:51—end

6. *What can a career of an engineer provide for a person according to the track?*
7. *Do you agree that engineering is our future? Why?*

Post-listening

8. *Watch the video again and try to make your own comments (you should make sentences to perform a small text about the video).*

3. WHAT IS ENGINEERING?
(A real video lecture)
(10:08)

Pre-listening

1. *What is engineering? Is engineering for you? Why did you choose engineering as a profession?*
2. *What may a lecturer speak about in the lecture "What is engineering"?*

While-listening

Listen to the video part by part **without watching** and answer the following questions.

00:00—00:15

3. *What is the main aim of the lecture?*

00:16—00:53

4. *What do engineers do every day?*
5. *What does engineering technology improve?*
6. *What can we call engineers in other words?*

00:54—03:15

7. *What are the attributes of a real engineer? List 10 attributes.*

03:25—04:22

8. *What should an engineer be able to do? (seven items)*

04:23—05:05

9. *What does the word "design" mean? Fill in the gaps in the explanation with the words you hear:*
   Design is a ___________ of going from ___________ needs to a ___________ that meets those ___________.

05:06—05:48

10. *What product is it spoken about in this part?*

05:50—06:37

11. *What are important aspects of design? (two aspects)*
12. *What are measures of product design? (three measures)*

06:38—07:54

13. *What are the steps of a design process?*

Now **listen to and watch** the parts above again and check your answers.

07:55—09:40

Watch the video and answer the question.

14. *What is the idea of this part?*

Post-listening

Try to summarize this lecture and make a small text (15–18 sentences) to comment on the following.

— *What is the main aim of the lecture*?
— *What do engineers do every day*?
— *What does engineering technology improve*?
— *What can we call engineers in other words*?
— *What are the attributes of a real engineer*?
— *What should an engineer be able to do*?
— *What does the word "design" mean*?
— *What product is it spoken about in this part*?
— *What are important aspects of design*?
— *What are measures of product design*?
— *What are the steps of a design process*?

2. TYPES OF ENGINEERING

Part I

1. **What do engineers do? Use verbs to answer.**
2. **Read the four parts of one text (A—D) and put them into the correct order (1—4). Do not pay attention to the gaps.**

   Part A

   When you have decided which area you are interested in and thought realistically about what sort of person you are, then you can decide what sort of engineering you want to be.

   Part B

   Each of these three main areas can be divided again into specialist subjects: civil engineering covers mining and ___________ building, mechanical engineering covers aeronautical and ___________ engineering, electrical engineering covers ___________ and ___________.

   Part C

   There are lots of different types of engineering. The one thing they have in common is that they all use maths and science to improve industry and manufacturing. The whole science of engineering can be broadly divided into three main areas (or fields):

   — civil engineering (___________, ___________, etc.);
   — mechanical engineering (___________, ___________);
   — electrical engineering (___________, ___________, etc.).

Part D

Clearly there is a big difference between building a road and designing a computer system so the best advice for students is:

—Think carefully about which area of engineering interests you most. It is difficult to study if you are not interested—and you may do the job until you are 60 years old.

—Think about what sort of person you are. Will you be happiest working in an office, in a factory, or outdoors? Do you mind getting dirty? Do you want to work with other people or alone? If you like wearing high heels and beautiful clothes, you may not be happy on a building site.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 2*, *pg. 3*, *Ex. 2.*)

3. Look at the passage beginning with “There are ...”. Fill in the gaps with the following words.

• tools • electricity • buildings
• roads • lighting • machines

4. Now look at the passage beginning with “Each of these ...”. Fill in the gaps with the following words.

• electricity generation • bridge
• automobile • wiring

5. Read the whole text again and put the main ideas of each passage to the correct order of passages.

You need to think carefully about your personality.	
There are lots of different jobs in engineering.	
Think carefully about what you are interested in.	
Engineering is a big subject.	

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 2*, *pg. 3*, *Ex. 2.*)

6. Choose the best title to the whole text above.

—Your personality.

—Types of engineering.

—A job in engineering.

7. Read the text again and find the equivalents to the following expressions.

To make better; be classified; parts; if you don't like the subject; until you become a pensioner; working indoors; smart things you wear; may become unhappy.

8. Answer the questions about the text above.

1. How many types of engineering are there?
2. What is the one thing that they all have in common?
3. What do they use maths and science for?
4. How many main areas can engineering be broadly divided into?
5. What are they?
6. What are the examples of civil engineering?
7. What are the examples of electrical engineering?
8. What are the examples of mechanical engineering?
9. What two things should you mind when choosing a specific area of engineering?

9. Match the following words.

way • engineering (×2) • activity • answer • price • site • theory • life • idea • the problem • industry • generation • job • a solution • design • of person • into • in • building

1	practical		11	indoor	
2	to use		12	outdoor	
3	to define		13	building	
4	to design		14	to divide	
5	everyday		15	to improve	
6	civil		16	to be interested	
7	reasonable		17	types of	
8	expensive		18	bridge	
9	methodical		19	electricity	
10	sort		20	computer	

10. Give synonyms to the following words.

Answer; step-by-step technology; kind of; sort of person; to classify; inside the building; to use on practice; in order to evaluate; on a building site; to exchange information; to make better.

11. Translate the following sentences into Russian. Translate the idea, not word for word.

1. I'm interested in a computer design process.
2. Are you interested in electrical engineering?
3. What are you interested in?
4. You must study hard to improve your knowledge.
5. Maths and science improve industry and manufacturing.
6. What can you do to improve your memory?
7. Do you like working outdoors?
8. Not everybody likes working outdoors.
9. Working indoors can help you improve your health.
10. Civil engineering covers mining and bridge building.
11. Your question covers many topics to think about.
12. Mechanical engineering is one of three types of engineering.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. MAIN BRANCHES OF ENGINEERING

Read the text and fill in the gaps with the following words.

• Civil • divided • buildings • types
• chemical • Electrical • discipline
• roads • telecommunications
• areas • engineering • engines
• systems • Mechanical

Engineering is a broad (*1*) ___________ which is often (*2*) ___________ into several subdisciplines. These disciplines concern different (*3*) ___________ of engineering work. Although an engineer will be trained in a specific discipline, during an engineer's career the engineer may become multi-disciplined and work in several areas. Historically the main branches (or (*4*) ___________) of engineering are categorized as follows:

(*5*) ___________ engineering—the design and construction of public and private works—(*6*) ___________, railways, water supply, bridges, and (*7*) ___________.

(*8*) ___________ engineering—a very broad area that may include the design and study of various electrical & electronic (*9*) ___________, such as electrical circuits, generators, motors, electromagnetic/electromechanical devices, electronic devices, electronic circuits, optical fibers, optoelectronic devices, computer systems, (*10*) ___________.

(*11*) ___________ engineering—the design of physical or mechanical systems, such as (*12*) ___________, powertrains, kinematic chains, vacuum technology, and vibration isolation equipment.

Also, nowadays there are some other small subbranches such as aerospace engineering, (*13*) ___________ engineering, computer engineering, medical (*14*) ___________, biological engineering, art engineering, and many others.

2. CIVIL ENGINEERING

Read the text and fill in the gaps with the following words.

• buildings • bridges • companies • discipline
• engineering • design • engineer

First the term "engineering" referred only to construction of military objects. Later, as the design of civilian structures such as (*1*) __________ and buildings became a technical discipline, the term "*civil engineering*" entered the lexicon. This was done to distinguish between those specializing in the construction of such non-military projects and those involved in the older discipline of military engineering.

Civil engineering is a professional engineering (*2*) __________ that deals with the (*3*) __________, construction and maintenance of the physical and naturally built environment, including bridges, roads, canals, dams and (*4*) __________. Civil (*5*) __________ is the oldest engineering discipline after military engineering. It is traditionally broken into several subdisciplines including environmental engineering, geotechnical engineering, structural engineering, transportation engineering, municipal or urban engineering, water resources engineering, materials engineering, coastal engineering, construction engineering. Civil engineering takes place on all levels: in the public sector from municipal through to federal levels, and in the private sector from individual homeowners through to international (*6*) __________.

A civil (*7*) __________ (in English usage) is a person who practices civil engineering. Originally a civil engineer worked on public works projects and was contrasted with the military engineer, who worked on armaments and defenses.

3. MECHANICAL ENGINEERING

Read the text and fill in the gaps with the following words.

• Mechanics • engineer • Kinematics • combination
• Engineering • skills • Thermodynamics • field

The inventions of Thomas Savery and the Scottish (*1*) __________ James Watt gave rise to modern mechanical (*2*) __________. The development of specialized machines and their maintenance tools during the industrial revolution led to the growth of mechanical engineering both in its birthplace Britain and abroad.

The (*3*) ___________ of mechanical engineering is a collection of many mechanical subdisciplines. Some of these subdisciplines are unique to mechanical engineering, while others are a (*4*) ___________ of mechanical engineering and one or more other disciplines. Most work that a mechanical engineer does uses (*5*) ___________ and techniques from several of these subdisciplines. Among these subdisciplines are:

— (*6*) ___________ (the study of forces);
— (*7*) ___________ (the study of the motion of objects);
— mechatronics and robotics (the creation of hybrid systems);
— (*8*) ___________ (the study of energy);
— drafting or technical drawing (the creation of instructions for manufacturing parts);
— structural analysis (the study of why and how objects fail and how to make them safe), etc.

4. ELECTRICAL ENGINEERING

Read the text and fill in the gaps with the following words.

• engineers • Power • 1872 • Electronic
• Signal • Processing • Electronics
• Control • Engineering • Microelectronics

Electrical engineering appeared in the 19th century with the invention of the electric motor in (*1*) ___________. The work of James Maxwell and Heinrich Hertz in the late 19th century gave rise to the field of (*2*) ___________. The later inventions of the vacuum tube and the transistor further accelerated the development of electronics to such an extent that electrical and electronics engineers currently outnumber their colleagues of any other engineering specialty.

The modern electrical (*3*) ___________ covers a range of subtopics. The most popular subdisciplines are:

—(*4*) ___________ engineering (deals with the generation, transmission, distribution of electricity);

— (*5*) ___________ engineering (focuses on the modeling of a diverse range of dynamic systems and the design of controllers);
— (*6*) ___________ engineering (involves the design and testing of electronic circuits);
— *7*) ___________ (deals with the design of small electronic circuit components);
— (*8*) ___________ engineering (deals with the analysis and manipulation of signals);
— telecommunications (focuses on the transmission of information across a channel);
— instrumentation engineering (deals with the design of devices and tools), etc.

Usually electrical (*9*) ___________ focus on one of these subdisciplines, but sometimes they deal with a combination of them.

5. ENGINEERING AND OTHER SCIENTIFIC DISCIPLINES

Read the text and fill in the gaps with the following words.

• design • chemical • analysis
• branches • expensive • products

Chemical engineering developed in the 19th century during the Industrial Revolution. Industrial manufacturing demanded new materials and new processes and by 1880 the need for large-scale production of chemicals was such that a new industry was created. The role of the (*1*) ___________ engineer was the design of these chemical plants and processes.

Aeronautical engineering deals with aircraft (*2*) ___________. Its origins can be traced back to the aviation pioneers around the turn of the century from the 19th century to the 20th. Early knowledge of aeronautical engineering was largely empirical with some concepts and skills imported from other (*3*) ___________ of engineering. Aerospace engineering is a more modern term that expands the reach envelope of the discipline by including spacecraft design. This includes the design of aircraft, spacecraft, and related topics.

Forensic engineering is the study of failed (*4*) ___________. It can help the product designer in evaluating his or her design in the light of real conditions. The discipline is of greatest value after disasters, such as bridge collapses, when careful (*5*) ___________ is needed to establish the cause or causes of the failure.

Computer engineering plays an increasingly important role in our modern world. As well as the typical business application software there are a number of computer-aided applications (computer-aided technologies) specifically for engineering. Computers can be used to generate models of fundamental physical processes, which can be solved using numerical methods. One of the most widely used tools in the profession is Computer-Aided Design (CAD) software which enables engineers to create 3D models. CAD allows engineers to create models of designs that can be analyzed without having to make (*6*) ___________ physical prototypes.

There are also many tools to support specific engineering tasks such as Computer-Aided Manufacture (CAM) software, Computer Numerical Control (CNC) software, Manufacturing Process Management (MPM) software and others. In recent years the use of computer software to aid the development of goods has collectively come to be known as Product Lifecycle Management (PLM).

• body • engineer • human
• development • solutions • biological

Medical and biological engineering deals with study of the human (*7*) ___________. Medicine aims to sustain, enhance and even replace functions of the (*8*) ___________ body, if necessary, through the use of technology. Modern medicine can replace several of the body's functions through the use of artificial organs and can alter the function of the human body through artificial devices such as implants. The fields of bionics and medical bionics are dedicated to the study of synthetic implants pertaining to natural systems.

Some engineering disciplines view the human body as a (*9*) ___________ machine. This has led to fields such as artificial intelligence, neural networks, fuzzy logic, and robotics.

Medicine, in part, studies the function of the human body. The human body, as a biological machine, has many functions that can be modeled using engineering methods. The heart, for example, functions much like a pump, the skeleton is like a linked structure with levers, the brain produces electrical signals, etc. These similarities as well as the increasing importance and application of engineering principles in medicine, led to the development of the field of biomedical engineering that uses concepts developed in both disciplines.

Both fields provide (*10*) ___________ to real world problems.

Art engineering includes architecture, landscape architecture and industrial design. The Art Institute of Chicago, for instance, held an exhibition about the art of NASA's aerospace design. Robert Maillart's bridge design is perceived by some to have been deliberately artistic. At the University of South Florida, an engineering professor, through a grant with the National Science Foundation, has developed a course that connects art and engineering. Among famous historical figures Leonardo Da Vinci is a well-known Renaissance artist and (*11*) ___________, and a prime example of the connection between art and engineering.

Social engineering. By its very nature engineering is closely connected with society and human behavior. Every product or construction used by modern society will have been influenced by engineering design. Engineering design is a very powerful tool to make changes to environment, society and economies, and its application brings with it a great responsibility. Most of engineering societies have established codes of practice and codes of ethics to guide members and inform the public at large.

Engineering is a key driver of human (*12*) ___________. Sub-Saharan Africa in particular has a very small engineering capacity, which results in many African nations being unable to develop crucial infrastructure without outside aid. The attainment of many of the Millennium Development Goals requires the achievement of sufficient engineering capacity to develop infrastructure and sustainable technological development.

Today there are a lot of charitable organizations which aim is to use engineering directly for the good of mankind. Among these organizations are the following ones: Engineers Without Borders, Engineers Against Poverty, Registered Engineers for Disaster Relief, Engineers for a Sustainable World.

Political engineering deals with forming political structures using engineering methodology and political science principles.

6. SCIENTISTS AND ENGINEERS

Read the following text and answer the questions.

1. Is there any difference between an engineer and a scientist?
2. What is the way that connects engineering and science?
3. What is common about engineering and science?
4. When may an engineer become a scientist?
5. What is the main difference between engineering and science?

"*Scientists study the world as it is*; *engineers create the world that has never been.*"

Theodore von Kármán

There exists a specific connection between the sciences and engineering practice. In engineering, people apply science. Both areas—science and engineering—rely on accurate observation of materials and phenomena. Both use mathematics and classification criteria to analyze and communicate observations.

Scientists must interpret their observations and make recommendations for practical action. Scientists may also have to complete engineering tasks, such as designing experimental apparatus or building prototypes. On the other hand, in the process of developing technology engineers sometimes explore new phenomena and become scientists themselves.

In the book *What Engineers Know and How They Know It*, Walter Vincenti says that engineering research differs from scientific research. First, it often deals with areas in which the basic physics and/or chemistry are well understood, but the problems themselves are too complex to solve in an exact manner. Examples are the use of numerical approximations to the Navier—Stokes equations to describe aerodynamic flow over an aircraft, or the use of Miner's rule to calculate fatigue damage. Second, engineering research employs many semi-empirical methods that are too far from pure scientific research, one example being the method of parameter variation.

As stated in the revision to the classic engineering text, *Foundations of Solid Mechanics*: "Engineering is quite different from science. Scientists try to understand nature. Engineers try to make things that do not exist in nature. Engineers stress invention. To embody an invention the engineer must put his idea in concrete terms, and design something that people can use. That something can be a device, a gadget, a material, a method, a computing program, an innovative experiment, a new solution to a problem, or an improvement on what is existing. Since a design has to be concrete, it must have its geometry, dimensions, and characteristic numbers. Almost all engineers working on new designs find that they do not have all the needed information. Most often, they are limited by insufficient scientific knowledge. Thus they study mathematics, physics, chemistry, biology, and mechanics. Often they have to add to the sciences relevant to their profession. Thus, engineering sciences are born."

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_2/)

1. CIVIL ENGINEERING
(02:12)

Pre-listening

1. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*

   Hydraulic, principle, be involved into, supervision, schedule, to run a business (= to manage, to control), timetable, to complete, completion.

2. *What are the main three areas that engineering can be broadly divided into?*
3. *Can these areas be divided again into subdisciplines? Yes or No?*
4. *What does civil engineering deal with?*

While-listening

Watch **the parts** of the video track and answer the following questions.

00:00—01:03

5. *Who is the speaker and what does he do?*
6. *How many subdisciplines does he mention?*
7. *What are they?*

01:04 — end

8. *What principles are used to create a design?*
9. *What activities are engineers involved into during their everyday life?*

Post-listening

10. *Summarize the information of the videotrack by filling each gap with a suitable word.*

The speaker is (*1*) ___________ Haritos, who is an Associated (*2*) ___________ of the Department of Civil and Environmental Engineering. He speaks about (*3*) ___________ ___________.

Civil engineering can be divided into (*4*) ___________ subdisciplines—(*5*) ___________ engineering (deals with soil and rock), (*6*) ___________ engineering (deals with structures—bridges, dams), (*7*) ___________ engineering (deals with water), (*8*) ___________ engineering (deals with roads, ports, harbors, airports).

To create a design two main kinds of principles are used—principles of (*9*) ___________ and principles of (*10*) ___________.

Engineers are usually involved into different kinds of activities during their everyday life. They (*11*) ___________, make schedules and (*12*) ___________, run the constructions, manage the completion of a construction and its budget.

2. ELECTRICAL ENGINEERING (03:10)

Pre-listening

1. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*

   Application, broad (field), to encompass (= to include), power optic communication, to simplify (= to make something easier to use), to contribute, light bulb, smoke-alarm, drought, age—aging, gadget.

2. *What does electrical engineering deal with?*

While-listening

Watch **the parts** of the video track and answer the following questions.

00:00—00:36

3. *Who is the speaker and what does he do?*
4. *What does electrical engineering deal with?*
5. *How often do we meet electrical problems?*

00:37—00:48

6. Is electrical engineering a broad field?

7. What subfields does electrical engineering encompass?

00:49—01:17

8. How does electrical engineering contribute to our society nowadays?

01:17—01:40

9. Do electrical engineers work alone or solve problems together with engineers from other fields?

10. What are the problems of today that electrical engineers have already started to solve?

01:41—02:00

11. What is the problem in Australia today?

12. How do electrical engineers solve this problem?

02:31—end

13. Do electrical engineers design goods for old people?

14. What do they design?

Post-listening

15. Summarize the answers to the video and make your own text on the topic of electrical engineering.

3. MECHANICAL ENGINEERING (03:29)

Pre-listening

1. Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.

Aim, ability, to equip, a graduate.

2. What does mechanical engineering deal with?

While-listening

Watch **the parts** of the video track and answer the following questions.

00:00—00:39

3. Who is the speaker and what does he do?

4. What does mechanical engineering deal with?

00:40—01:36

5. *What are the subdisciplines of mechanical engineering that are mentioned in the video track?*
6. *Do mechanical engineers work alone or together with engineers from other fields?*
7. *How often do mechanical engineers solve problems?*

01:37—02:32

8. *What is the aim of teaching the discipline of mechanical engineering?*

02:33—03:29

9. *Where can the graduates with a degree in the mechanical engineering work?*

Post-listening

10. *Summarize the answers to the video and make your own text on the topic of mechanical engineering.*

3. MAKING THE RIGHT CHOICE

Part I

Section A

1. Look at the picture and answer the following questions.

1. Is it indoors or outdoors?
2. What kind of room is this?
3. Who are the people in the picture?
4. Do you think they are just students or they work and study to improve education? Why?
5. What kind of a lesson is it? Why?
6. Do you think they are interested in this lecture? Why?
7. Do you think this lecture covers technical aspects?

2. Answer the following questions about yourselves. Compare your answers with a partner.

1. What subjects do you study? Are there any subjects you would like to drop?

2. Is your course practical? Do you like this way of working?
3. How are you assessed? Do you think this is fair?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 3*, *pg. 4*, *Ex. 1.*)

3. Read the following text and choose the correct answers to the questions (1–3) below.

1. Where is the text from?
   (a) A textbook. (b) A leaflet.
2. Who is the information for?
   (a) New students. (b) Teachers and parents.
3. What is the text about?
   (a) One course. (b) Lots of courses.

Who is the First Diploma for?

It is a **foundation course** for students with a general interest in engineering. You will learn about the different types of engineering; you do not **specialize** in one area.

What qualifications do I need?

You need the following **qualification**s. You must be at least sixteen years old with an interest in engineering. You need at least three GCSEs including mathematics, science, and design and technology.

What will I learn on the course?

You will learn:
— practical skills in manufacturing and maintenance;
— about engineering materials, computer-aided design (CAD), engineering measurement;
— **key skills** in information technology (IT).

How will I study?

The course is full-time for one year. You will spend some time in the classroom but most of your time will be spent doing practical tasks in the workshop, in the laboratory, or on computer screen.

How will I be assessed?

Each project is marked (**continuous assessment**) and there are tests at the end of each term.

What can I do when I finish the course?

You can use your first diploma to help you to find a job as an **apprentice**. Alternatively, you can continue your studies and specialize in the area that interests you most.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 3*, *pg. 4*, *Ex. 2.*)

4. Read the text again and find the equivalents to the following expressions.

A basic course (a course for beginners, a course to start with); focus on; certified theoretical and practical knowledge; basic skills; a place where practical tasks are done; room to organize experiments; is assessed; half a year; an assistant.

5. Read the text again and decide if the sentences (1–5) below are true (T) or false (F).

1	The first diploma is a beginner-level course.	T	F
2	Students learn general things about engineering.	T	F
3	The course isn't practical.	T	F
4	Students take one big exam at the end of the year.	T	F
5	At the end of the course, you can apply for a job as a trainee.	T	F

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 3*, *pg. 4*, *Ex. 3.*)

6. Complete the following definitions with the words in bold type in the text.

1. To "___________" means to know a lot about one part of a subject.
2. "___________" means all your work on the course is part of the final mark.
3. ___________ are the most important things to learn.
4. A ___________ teaches you general things about a subject.
5. An ___________ is someone who works with an experienced person to learn the job.
6. You get ___________ when you pass exams.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 3*, *pg. 4*, *Ex. 4.*)

7. Guess the word as it is shown in the example: *illsk = skill.*

etrm	cerenappti
nertrai	essassment
zeciaspeli	neetrai
datifounon	tionfiliquaca
urseco	shoprkwo

8. Give synonyms to the following words using the words from the module.

Beginner course; to focus on something; certified theoretical and practical knowledge; basic skills; practical seminar; evaluation; half of a year at University; trainee; instructor.

9. Guess the words from their definitions.

1. A general course at a college that prepares students for more difficult courses.
2. To give particular attention (to focus on) to a subject.
3. A degree, a diploma, a certificate; theoretical and practical knowledge.
4. An ability that you need in order to get a job; when you can do something well.
5. A person who works for low pay in order to learn the skills he needs to a particular job.
6. A fixed period of time during which students attend classes and after which they take exams.
7. A person who trains (teaches) people for some particular job.
8. A type of job when you work for 8 hours a day and 5 days in a week.
9. A lesson of discussion and practical work, when people communicate and show their knowledge.
10. The process of getting marks for each project you do during the term.
11. Basic knowledge of any subject that you need for your future study.
12. A room or a building used for scientific experiments or testing.
13. The process when you keep something in good condition (see the text above).

10. Translate the following sentences into Russian. Translate the idea, not word for word.

1. He finished his foundation course two years ago.
2. “What are you doing this year?”—“I’m at my foundation course.”
3. What do you need to take the foundation course?
4. Will I get a certificate after this foundation course?
5. What kind of engineering do you want to specialize in?
6. She specializes in civil engineering.
7. This manufacture specializes in car-production.
8. You don’t need to specialize during the foundation course.
9. After the foundation course you should specialize in one type of engineering.
10. What sort of qualification do you need for the job?
11. He has got all the qualifications for the job.
12. I can take any person without qualifications to this kind of job.
13. Do you have any qualifications we need for the course?
14. She has got good skills in solving problems.
15. The foundation course will teach you practical skills in manufacturing and maintenance.
16. It is very important to have key skills in information technology.
17. Practical skills are needed to get a good job.
18. Have you got any practical skills during that course?
19. Practical skills are very important if you want to become a successful engineer.
20. What do you need for the maintenance of these materials?
21. What do you do to maintain your family wellness?
22. Is it your last term at the University?
23. Today is my first exam after the first term.
24. Were you good during the last term?
25. What skills are you going to get during your future term?
26. How were you assessed for your last term?
27. What is the process of assessment in your University?
28. Continuous assessment means that each project during the term is assessed by the teacher.
29. It’ll be not easy to get assessment for the course.
30. You must work hard in order to be successfully assessed.

31. "Do you work full-time?"—"No, I'm an apprentice, so I work part-time."
32. Do you think that it's better to work part-time or full-time?
33. I'm a new apprentice, who is my trainer?
34. So, Nick, you'll be an instructor to this group of young trainees.
35. Are you ready to take part in a workshop?
36. What was the last workshop about?
37. Were you at the last workshop on information technology?

11. Answer the following questions about your course and write a small text about it.

1. Who is the course for?
2. What qualification do you need?
3. What do you learn during the course?
4. How do you study?
5. How are you assessed?
6. What can you do when you finish the course?

Section B

1. Read the following questions. Study the meaning of the words that you don't know. Think and try to answer them.

1. What course are you doing at the moment?
2. When did you start this course?
3. Did you choose this course yourself? Did anybody help you to choose this course?
4. Where did you take information about this course? (advertisement on TV, a leaflet, personal experience, friend's advice)
5. Did you have an interview before this course?
6. Why do people take interviews?
7. What do people do during interviews?
8. What kind of questions do people ask?
9. Is it difficult for you to take an interview? Why?
10. Did you *apply in writing* for the course?
11. Did you *fill in an application form*?
12. Was it difficult? Why?
13. What is the usual information in an application form?

2. Read the following text and choose the correct answers to the questions below.

1. What is the leaflet about?
   (a) Engineering courses at Coalport Technical College.
   (b) All courses at Coalport Technical College.
2. What does the leaflet describe?
   (a) Lots of courses. (b) One course.
3. How can you get more information?
   (a) By telephoning. (b) By returning the form.
4. How many levels are there?
   (a) Two. (b) Four.

ENGINEERING COURSES

At Coalport Technical College, Blackstock

All courses are taught at Coalport Technical College, Blackstock and can be studied full-time or part-time. The minimum qualification for a place on a Level 2 course is four GCSEs or a Level 1 Certificate.

1. *LEVEL 1 — Certificate in Engineering*

This course teaches basic, key skills. It is suitable for students who left school early or have no qualifications. Selection will be based on the **applicant**'s work experience and an **interview**.

2. *LEVEL 2 — Certificate in Electrical and Electronic Engineering*

This course **prepare**s students for jobs in radio and electronic **communications**.

3. *LEVEL 2 — Certificate in Fabrication*

This course prepares students for jobs in **welding**, sheetmetal work, and general engineering.

4. *LEVEL 2 — Certificate in Mechanical Engineering*

This course prepares students for a wide range of jobs including machining, **fitting**, tool-making, CAD and CAM.

For more information, please, visit our website or return this form to the department secretary.

Name ____
Address ____
Telephone/e-mail ______________________________________
Date of birth ____

Please send me details of:

LEVEL 1 — Certificate in Engineering ☐
LEVEL 2 — Certificate in Electrical and Electronic Engineering ☐
LEVEL 2 — Certificate in Fabrication ☐
LEVEL 2 — Certificate in Mechanical Engineering ☐

I'm interested in full-time study ___ part-time study ___

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 4*, *pg. 5*, *Ex. 2.*)

3. Read the text again and match the people (A–E) below with a suitable course (1–4). One person isn't suitable for any of the courses.

Person A finished Level 1 last year. He wants to work as a welder on oil rigs.	
Person B got her exam results last week. She passed maths, design and technology, english, and history. She wants to work in design.	
Person C works in her father's garage. She hasn't passed any exams but she is good at mending cars and wants to return to studying.	
Person D left school in 2000 with no exam passes. Since then he has worked in a jeans shop and a hamburger café.	
Person E has five GCSEs and wants to work as a telephoning engineer.	

(*“Engineering” Workshop by Lindsey White, OUP; Unit 4, pg. 5, Ex. 3.*)

4. Complete the definitions below with the words in bold type in the text.

1. “____________” is joining metal by heating.
2. An “____________” is a formal meeting.
3. “____________” means putting machinery in place.
4. “____________” are ways of sending information, news, etc., from one place to another.

5. An “___________” is a person who wants a job or a place on a course.
6. To “___________” is to make something ready.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 4*, *pg. 5*, *Ex. 4.*)

5. Find the mistakes in spelling of the following words and correct them. Only one word is correct.

An aplicant; to pass exem; a welde; suitable for; certifikate; inteview; fiting; applikation form; to pripare; expirience.

6. Guess the words from their definitions.

1. A person who wants to get a job or a place at a university.
2. Something that you have done in your life; the knowledge or skill that you have got while doing something.
3. A meeting when one person asks another person different personal questions.
4. To take an exam and to get good mark at it.
5. People who study something.
6. A person whose job is to join pieces of metal together by heating them.
7. An official document that says about your skills or knowledge.
8. A type of engineering that deals with moving parts of things.
9. An official paper that a person fills in when he or she wants to get a job or a place at a university.
10. A certificate that a person gets after passing of all exams after the completion of a course of study.

7. Translate the following sentences into Russian. Translate the idea, not word for word.

1. You must apply for a visa immediately.
2. I’m filling in an application form at the moment. Could you wait for some time?
3. Where should I apply for a new passport?
4. We have 20 applicants for this job.
5. Please ask another applicant to come in.
6. I need to fill in an application form in English.
7. How long will you fill in this application form?

8. We must test our new applicant for the job and evaluate his knowledge.
9. To take exam doesn't mean to pass it.
10. During this course you will take exams after each term.
11. After you pass the exam you may become an apprentice.
12. Passing an exam means that you have got a certain qualification.
13. To be good at practice you should work more in a workshop.
14. Laboratory studies help to get practical skills.
15. After you pass all the exams you'll get a certificate.
16. How long do you usually prepare for exams?
17. Experience comes after practice.
18. I think that the last applicant is the most suitable for the job.
19. We must find a suitable person among five applicants.
20. A company needs a welder with experience.

8. Fill in the gaps in the following text with suitable words from *Section B* of this module.

GETTING A JOB

Usually at the end of the 5th year of education all students (*1*) ___________ final exams. If they are (*2*) ___________ at exams (= *if they* (*3*) ___________ *them with good marks*), they get a (*4*) ___________ (or a (*5*) ___________). Students become young specialists. Now they are ready to (*6*) ___________ a job in any company they want. Each person who wants to get a job is called an (*7*) __________. Each of them should (*8*) ___________ an (*9*) ___________ where he/she must write general information about himself/herself and specific information about his/her qualifications. Usually selection is made after an (*10*) ___________ with each candidate where he/she answers a number of questions about his/her theoretical and practical knowledge. Each person should (*11*) ___________ for this talk carefully to show how intelligent he/she is. Also it is good if you have any (*12*) ___________. If a boss thinks that a person is (*13*) ___________ a job, he/she gets it and begins his/her career.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. WHY STUDY ENGINEERING?

(*adapted from http***://***www.science-engineering.net***)**

1. **Think of pluses of studying engineering and write down a list of advantages.**
2. **Read the text and fill in the gaps with the following words.**

• level • industry • manufacture • experience
• knowledge • engineer • progress • design • systems
• everyday • career • key • qualification

Engineering is the way of realization of technological (*1*) ___________. Engineers and engineering make a major impact in (*2*) ___________ lives of most of us. Engineering qualifications and (*3*) ___________ are a foundation for many different careers.

Nowadays we can talk about engineering "globalization". In many engineering activities we see a new kind of challenge emerging—international business structures. Research and development (R&D) can take place in one location; materials and subassemblies can be taken from several locations worldwide; (*4*) ___________ can take place in areas located far from R&D and raw material supply; and final markets can be anywhere. The skill of an engineer in designing information (*5*) ___________ and configuring operational technology determines how all this fits together competitively and profitably. It means that an (*6*) ___________ can face the challenge of coping with multi-location, multi-cultural relationships at a very early stage of a (*7*) ___________.

Engineers have been at the forefront of turning time into a distinguishing feature of the product creation process. With a faster and more even distribution of "know-what" and "know-how" the difference between success and failure can depend on speed-to-market. This requires a high (*8*) ___________ of engineering (*9*) ___________ and skill in operational system (*10*) ___________ and supply chain management to achieve what is commonly termed "time compression".

Engineers have often found themselves in (*11*) ___________ positions in (*12*) ___________ and manufacturing and are able to earn high salary that depends on experience and (*13*) ___________.

3. **Read the text again and compare your list of advantages with the list of advantages mentioned in the text.**

2. STUDYING ENGINEERING IN THE UK

(*adapted from http***:***//www.science-engineering.net***)**

1. **Read the texts and fill in the gaps with the following words.**

Science and Engineering

• engineering • science • travel
• technology • natural

People seek (*1*) ___________, engineering and (*2*) ___________ courses for many reasons. Some have specific goals: they wish to cure diseases or combat hunger or reduce pollution; or they dream of developing the next laser, transistor, or vehicle for space (*3*) ___________; or they imagine building companies that capitalize on new engineering capabilities. Some choose careers in science or (*4*) ___________ because they are curious about the (*5*) ___________ world. Others are motivated by the excitement and beauty of the intellectual world.

Engineering Students in the UK

• students • engineering • managed • improve
• levels • course • qualification

According to figures published by the Higher Education Funding Council for England, UK universities are among the best in the world. This high success rate is due to the following facts: the university selection process is carefully (*6*) ___________ to ensure the right students are matched to the right degree (*7*) ___________; much of the teaching is in small groups that ensures high (*8*) ___________ of individual attention.

There are a number of advantages of studying (*9*) ___________ in the UK, both at undergraduate and postgraduate level. The education that students receive is of a very high standard, and a professional engineering (*10*) ___________ from the UK is accepted and recognized internationally. International students also have an opportunity to develop and (*11*) ___________ their working and spoken English skills, and to experience British culture. The universities and professional engineering institutions are structured to give help and support to international (*12*) ___________.

• management • civil • Diploma • specialize
• courses • engineers • skills

The universities offer a huge variety of engineering courses. They may be in one of the main disciplines, such as (*13*) ___________, mechanical and electrical engineering, or in a specific sub-discipline of engineering, such as aerospace or automotive. A modular course is suitable for students who do not want to (*14*) ___________ too early, or who want freedom to combine study in specific areas of engineering. In addition, many UK universities now include "soft" business (*15*) ___________ into the curriculum. These are becoming an essential part of most jobs, and include economics, (*16*) ___________, communication and accountancy modules.

Some years ago, the professional engineering institutions set up a (*17*) ___________ in Engineering Management. This has been transformed into a series of (*18*) ___________, which let the student to get an MBA, MSc or Doctorate in Engineering Management. This is ideal for leading research (*19*) ___________ who aim at key managerial positions in industry.

International Engineering Students in the UK

• process • apply • applicants • study
• part-time • solved • experience
• partnerships • level • students

Many university courses now involve (*20*) ___________ in continental Europe. The MEng course at Bristol University, for example, has set up exchange (*21*) ___________ with France, Italy, Germany, Spain, Sweden, Finland, and the Netherlands. The university also runs an aerospace integrated graduate development (IGDS) scheme, a modular programme that can be done as individual short courses or combined to form part of a Master's degree. International (*22*) __________ must have three-to-five years of postgraduate experience and a suitable (*23*) __________ of English. Delegates on current courses come from South Korea, Australia, Indonesia, South Africa, Singapore, and other EU countries.

In the UK, work (*24*) __________ is now considered an important part of the learning (*25*) __________. The British Government has recently introduced a number of changes designed to make it easier for international students to combine study with work during term time and vacations. This was a part of a plan to increase the number of foreign (*26*) __________ in the UK. The problems with payments and visa arrangements have been (and are being) (*27*) __________. Now international students can work (*28*) __________ while studying or during vacations. It is important to remember that international students who (*29*) __________ for a visa to the UK must have money to be able to support themselves. Paid work that is carried out as part of the higher or further education is taken into account in such calculations.

The UK scholarships, grants, and other awards

• apply • students • practical • three
• money • country • contact • financial
• details • course • universities

The UK government and other UK organizations provide a number of scholarships and awards to help international (*30*) __________, but these tend to be limited. Most grant makers in the UK have strict rules about whom they will and will not give (*31*) __________. An offer at a UK university does not automatically mean you will get a grant. International students are advised to (*32*) __________ the Ministry of Education or Education Department in their own country first.

The British Council can provide (*33*) __________ of different scholarship schemes offered by the UK government, and by academic departments at colleges and (*34*) __________.

There are also a small number of charitable trusts that offer limited (*35*) __________ support. This allows students to register for a related higher degree. European funding is also available under the European Community Action Scheme for the Mobility of University Students—the Socrates Erasmus Scheme. All UK universities and every (*36*) ___________ in Europe (apart from Switzerland) are part of the scheme. Students, who have completed their (*37*) ___________ but want to stay on for (*38*) ___________ training, work experience or a graduate training programme in the UK, may do so under the Training and Work Experience Scheme (TWES). According to this scheme employers may (*39*) ___________ for a permission to employ a person, usually for a maximum of (*40*) ___________ years.

2. Read the text again and decide if the following sentences are true (T) or false (F).

1	Different factors influence the choice of a course.	T	F
2	Studying in small groups produces better results.	T	F
3	Students from abroad may not only study engineering in the UK but also improve their English.	T	F
4	Students in the UK have a very little choice of courses.	T	F
5	Nowadays all students in the UK study the course on “soft” business skills.	T	F
6	Getting a Diploma in engineering management helps to become a top manager.	T	F
7	The knowledge of English is not important for students who want to apply for a Master’s Degree.	T	F
8	Students who want a Master’s Degree must have work experience.	T	F
9	The British Government is not interested in international students.	T	F
10	It is important for international students to have enough money to live and study in the UK.	T	F
11	Every international student in the UK gets a grant.	T	F
12	A person who completed the course can’t stay in the UK to work for more than three years.	T	F

3. CHOOSING A COURSE IN THE UK

(*adapted from http*://*www.science-engineering.net*)

1. Read the text and fill in the gaps with the following words.

• experience • special • carefully
• course • part-time • assessment
• interested • problems • answer
• information • international

Are you thinking of coming to the UK to study? Then you must have got lots of questions that need to get answers. First of all, before choosing a (*1*) __________, you should think of the fact whether you're (*2*) __________ in the subject or not. Although a good degree is always important, there is a number of things you should think (*3*) __________ about in advance of your trip overseas. So get reading!

1. Compare the content of courses and the style of learning offered at each institution. Sometimes degree and courses with the same name may be very different at each university or college.
2. Does a university offer any kind of work (*4*) __________ as part of the course (if that is important to you)?
3. How many students get relevant jobs at the end of the course? Some universities list their statistics on their websites.
4. Compare the quality (*5*) __________ reports for research and teaching in Higher Education universities and colleges at the Quality Assurance Agency—HEFCE (Higher Education Funding Council for England), Scottish Higher Education Funding Council, Welsh Funding Councils. This may be useful in choosing between universities.
5. Find out about social issues, including the range of social, sports and cultural activities, the cost of living, whether the university is on a campus outside of any town or based in a city and the geography of local region may all be important to you in your decision. There are some publications which grade universities according to students' views, which you may find in your local library, careers office and in British Council offices, if you are an international student. It is al-

ways helpful if you can visit the universities you are interested in. Look out for or ask about Open Days when staff and students will be available to (*6*) ___________ any questions.

6. If you are a disabled person, there is (*7*) ___________ information available at websites of colleges and universities.
7. Are there any services for student's support (such as Students' Counsel, health and childcare support)? Student services staff in universities and colleges will also provide (*8*) ___________ and support in helping you make decisions about choosing your courses or dealing with any questions you may have.
8. Would you like to work (*9*) ___________ while you are studying and is it possible with the university?
9. Is there any support for (*10*) ___________ students? If you are bringing a family with you, or want to meet with other international students, or need any language help, perhaps before you start your course, you should find out in advance what support there is for international students and their families from the university or college. Most universities and some FE colleges have International Officers to give you advice and information and help with any (*11*) ___________ you may have.

2. Read the text again and decide if the following sentences are true (T) or false (F).

1	Courses in different universities in the UK that have one and the same name always teach one and the same disciplines.	T	F
2	There are special organizations in the UK that assess different universities and rate them in order of quality of education.	T	F
3	If you have serious health problems, you can find special information about the process of study for you on website of a university.	T	F
4	Each university gives permission to students to work part-time while they are studying.	T	F
5	There is not any organization in the UK universities that help international applicants and students.	T	F

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_3/)

1. CHOOSING A CAREER
(00:43)

Pre-listening

1. *What do engineers do in their career?*
2. *Why did you choose to become an engineer?*
3. *What makes people choose this or that career?*
4. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*
   Choice, scientist, community.

While-listening

Watch the video and answer the following questions.

5. *Who is the speaker and what does he do?*
6. *What type of engineering does he specialize in?*
7. *What made the speaker choose the engineering career?*

Watch the video again and fill in the gaps in the following text.

When I thought about civil (*1*) ___________ as a possible career choice, that choice was mostly dictated by the (*2*) ___________ that I had an (*3*) ___________ insides physics, chemistry, and (*4*) ___________ but did not see myself as a (*5*) ___________. I wanted to be able to apply the (*6*) ___________ of sciences in a (*7*) ___________ way that could be (*8*) ___________ to the community. And that's what really sparked off my interests in (*9*) ___________ engineering as a career choice.

Post-listening

8. *Make a list of facts that may influence the choice of a civil engineering career (mechanical engineering career, chemistry engineering career, electrical engineering career). What is different and what do they have in common?*

2. CHOOSING __________ __________ AS A CAREER

(02:01)

Pre-listening

1. *What do people have to think about when they choose their future career?*
2. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*

   To apply something, to take things apart, to create (creative), to come up with (a solution), to get involved, lab = laboratory.

While-listening

Listen to the video **without watching** and answer the following questions.

3. *What are the people talking about? Complete the heading.*
4. *How many speakers are there?*

Watch the video track, do the following assignment, and answer the following questions.

5. *Put the names of the speakers in the order of appearance in the track.*

Ryan Patterson	
Renae S. Tichy	
Chris Nieport	
Sean A. Falkowski	
Ben Staub Jr.	
Margaret M. Middleton	
Dave Myszka	
Susan Kotowski	
Jeff Wolff	

6. *Where do all the speakers work?*

Watch **the parts** of the video track and do the following assignments.

00:01—00:19

7. Complete the following text with the words that you hear.

If you like to (*1*) ___________ yourself, you like to take (*2*) ___________ things apart and then back together, if you (*3*) ___________ to see how something works just for sake of doing it, I think (*4*) ___________ ___________ would be what you like to do.

00:51—01:05

8. Complete the following text with the words that you hear.

Engineering (*1*) ___________ would be a good major for someone who doesn't just like to come up with an answer on paper or on a (*2*) ___________ but likes to take it on the next (*3*) ___________ and turn it into practical (*4*) ___________ and come up with that final (*5*) ___________.

01:14—01:33

9. Complete the following text with the words that you hear.

I wanna* be in a (*1*) ___________, I want to work with other (*2*) ___________, I wanna to, actually, work with my hands. ...I want to see all those seriously on (*3*) ___________ and I think people we actually wanna see help develop ideas, but actually see those ideas (*4*) ___________ to life. I think that what (*5*) ___________ ___________ is all about.

* wanna (*Am. slang*) = want to

01:44—01:54

10. Complete the following text with the words that you hear.

Do you like math and (1) ___________? Do you find (2) ___________ interesting? Do you find (3) ___________ interesting? If you do—this is for you!

Watch the whole video track again and answer the following questions:

11. Who

1	says that an engineer likes to see how things work?	
2	says that an engineer likes to take things apart?	
3	says that an engineer likes to create things?	

4	mentions any of disciplines that can be taught at school or university?	
5	says about the difference between working on a computer and working at a plant?	

Post-listening

12. Make a list of things that a person who wants to become an engineer in the sphere of engineering technology must like/or be interested in/or be good at:

"*A future engineer must...*"

4. MATERIALS AND THEIR PROPERTIES

Part I

1. Do you know the following materials? Match the materials to their definitions below.

• glass • plastic • metal

1	A type of solid substance that is usually hard and shiny, that conducts heat and electricity.	
2	Hard, transparent substance (material), produced by mixing sand with soda by glass-blowing process; usually used in windows.	
3	A light strong material that is made with chemicals and is used for making many different kinds of objects.	

What can be made of these materials?

Which material is the best for dishes?

2. Which is the best material for the following objects and why?

A fork, a football, a window, a bicycle, a plate.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 5*, *pg. 6*, *Ex. 1.*)

3. Read the information in the table below and put each heading into the correct column (A, B, or C). What is the order of materials in column A?

• Uses • Properties • Material

A ___________ B ___________ C ___________

1	aluminium	light, easy to shape	aircraft, window and door frames, cooking foil
2	brass (copper and zinc)	doesn't rust in contact with air and water, strong	valves, taps
3	cement	mixed with water it dries to a hard material	pre-made building blocks, to hold bricks together
4	copper	easily made into wire, carries electricity well	electrical wire, tubing
5	diamond	hardest natural material, can cut glass and metal	industrial cutting and grinding
6	glass	clear, hard, breaks easily	windows, bottles
7	iron	hard	engineering
8	mild steel (iron +0.15–0.3% carbon)	hard, strong, quite easy to shape	bridges, ships, cars
9	optical fibre	carries light and coded messages	lighting, cable TV, telecommunications
10	plastic	light, strong, easy to shape	hard hats, computer casing

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 5*, *pg. 6*, *Ex. 2.*)

4. Read the information in the table from Ex. 3 again and find out which material is best for:

(a) water pipes;
(b) a knife for cutting a microscope lens;
(c) connecting a socket to the electricity supply;
(d) a bicycle frame;
(e) television casing.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 5*, *pg. 6*, *Ex. 3.*)

5. Study the table in Ex. 3 again and complete the following table.

Verbs	Adjectives

6. Match the properties from the table with their opposites below. Use your glossary or dictionary to help you.

• heavy • tough • opaque
• rigid • weak • soft

1	breaks easily	
2	clear	
3	easy to shape	
4	hard	
5	light	
6	strong	

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 5*, *pg. 6*, *Ex. 4.*)

7. Find as many materials in the following line as you can (11 words).

glassircementoptironsebrasssteelydimanplasticrzidiamondcopperon-fibrealuminiumzincopl

8. Answer the following questions.

What material... (or what materials...):

— is the strongest?
— is/are easy to shape?
— conduct(s) electricity well?
— is/are found in people and fruits?
— break(s) easily?
— can be mixed with water?
— is/are very light?
— don’t (doesn’t) rust?
— can carry coded messages?
— is/are used in jewellery?
— is/are used in beer (or juice) production?
— is/are used a lot on a building site?

— is/are used in city advertising process?
— is/are used in manufacturing of cars, buses, aeroplanes, etc.?
— is/are widely used in cooking process?
— is/are used in industry to cut hard materials?

9. Look at the following materials and complete the table.

	A Material	**B** Properties	**C** Uses
1	wood		
2	rubber		
3	china		

10. What is the best material for the following things and why?

A cup, a car tyre, a frying pan, engineering tools, a mobile.

11. Fill in the gaps in the following sentences with suitable words from the module.

1. ___________ is a light silver-coloured metal that is easy to shape and that is used in window and door frames, and to make cooking foil.
2. "___________" means difficult to shape (= opposite to "easy to shape").
3. ___________ is used in cable TV and communications because it can __________ light and coded messages.
4. In a building process ___________ is used to hold bricks together.
5. Windows are made of ___________ because this material is ___________ (or transparent).
6. Dishes that are made of ___________ are beautiful but not practical because this material ___________ easily.
7. "___________" means not easily broken. The opposite to this word is "___________".
8. Industrial cutting and grinding often use ___________ because it is the hardest natural material.
9. Water pipes (or tubes) are usually made of ___________ because this metal doesn't ___________ in contact with water.

10. ___________ is used to make electrical wires because it is ___________ to shape this material and it ___________ electricity well.
11. ___________ is widely used today practically everywhere: to make dishes, to make computer (TV, radio, mobile telephone, etc.) casing, tubes because it is ___________, __________, easy to shape.
12. "___________" means "easy to lift", "not heavy".

12. Translate the following sentences into English. Translate the idea, not word for word.

"… (material) is … (properties)"

1. Пластик легкий и крепкий.
2. Латунь — крепкий материал, не подвергающийся коррозии.
3. Алюминий — легкий материал, который легко гнется.
4. Сталь — твердый и крепкий материал, которому довольно легко придать нужную форму.
5. Алмаз — самый твердый природный материал.
6. Медь — материал, который легко гнется.
7. Стекло — прозрачный, твердый материал, который легко бьется.
8. Оптическое волокно — материал, который может передавать сигналы.

"… (material) is used for/in/for manufacturing of …"

9. Сталь используется для строительства мостов, кораблей.
10. Алюминий используется в авиастроении.
11. Оптическое волокно применяется для кабельного телевидения.
12. Из пластика делают каркасы для телевизоров, компьютеров, магнитофонов.
13. Железо применяется для создания инженерного оборудования.
14. Из меди делают провода.
15. Цемент используют для производства кирпичей.
16. Из алюминия делают оконные рамы.

"… is/are made of/from … (material)"

17. Окна делают из дерева (пластика) и стекла.
18. Каркас телефона сделан из пластика.
19. Электрические провода сделаны из меди.
20. Пищевая фольга сделана из алюминия.
21. Мосты делают из стали.
22. Трубы делают из пластика или латуни.
23. Эта дверь сделана из дерева.
24. Строительные каски делают из пластика.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. MATERIALS

Read the text and fill in the gaps with the following words.

• manufacturing • production • discipline
• made • divided • properties (×2)
• materials • components • oil

Material is synonymous with substance. It is anything that is (*1*) ___________ of matter—hydrogen, air, and water are all examples of materials. Sometimes the word "material" is used more narrowly and refers to substances or (*2*) ___________ with certain physical (*3*) ___________ that are used in production or (*4*) ___________. In this sense, materials are the components that we need when we want to make something else (from buildings to computers).

A material can be anything: a finished product or a raw material. Raw (*5*) ___________ are materials that are taken from the earth and (*6*) __________ into a form that can be easily transported and stored. Then they are processed into semi-finished materials. These can be input into a new cycle of (*7*) __________ to create final products. The examples of raw materials are: cotton, coal, (*8*) ___________, etc.

In chemistry materials can be divided into metals and non-metals. Different materials have different (*9*) ___________. Materials and their properties are studied by a special (*10*) ___________ that is called Materials science.

2. MATERIALS SCIENCE

Read the text and fill in the gaps with the following words.

• focus • engineering • important
• discipline • chemistry • characteristics

Materials science is a (*1*) ___________ that studies the properties of matter and its applications to various areas of science and

(*2*) ___________. This science study the relationship between the structure of materials at atomic or molecular scales and their macroscopic properties. It includes elements of applied physics and (*3*) ___________. Nowadays scientists (*4*) ___________ their attention on nanoscience and nanotechnology, so materials science has been introduced to many universities. It is also an (*5*) ___________ part of forensic engineering and failure analysis. Materials science also deals with fundamental properties and (*6*) __________ of materials.

• properties • science • engineering
• technologies • scientist

Materials (*7*) ___________ is a very old scientific discipline. In ancient times the choice of the material gave the name to the era — for example the Stone Age, the Bronze Age, the Steel Age. Materials science is one of the oldest forms of (*8*) __________ and applied science, deriving from the manufacture of ceramics. Modern materials science evolved directly from metallurgy, which itself had evolved from mining. A major breakthrough in the understanding of materials occurred in the late 19th century, when the American (*9*) ___________ Josiah Willard Gibbs demonstrated that the thermodynamic properties related to atomic structure in various phases are related to the physical (*10*) __________ of a material. Important elements of modern materials science are products of the space race: the understanding and engineering of the metallic alloys, and silica and carbon materials, used in the construction of space vehicles. Materials science is driven by the development of revolutionary (*11*) ___________ such as plastics, semiconductors, and biomaterials.

• classified • materials • departments
• properties • understand

Before the 1960s many (*12*) ___________ of materials science at universities were named “metallurgy” departments. It was because of the fact that from the 19th and to early 20th century scientists put emphasis on metals. Since then the field has broadened and now includes every class of (*13*) ___________—ceramics, polymers, semiconductors, magnetic materials, medical implant materials, and biological materials (materiomics).

In materials science, the main aim is to (*14*) ___________ materials in order to be able to create new materials with the desired (*15*) ___________.

Materials science divides materials into various classes. Each of this class may form a separate field. Materials are sometimes (*16*) __________ by the type of bonding between the atoms: ionic crystals, covalent crystals, metals, intermetallics, semiconductors, polymers, composite materials, vitreous materials.

• characterized • Electronic • Metallurgy
• industry • divided • Biomaterials • Glass

Materials science can be (*17*) __________ into different disciplines that study different materials and their properties. For example:

(*18*) ___________—the study of metals and their alloys, including their extraction, microstructure, and processing.

(*19*) __________—materials that are derived from and/or used with biological systems.

(*20*) __________and magnetic materials—materials such as semiconductors used to create integrated circuits, storage media, sensors, and other electrical devices.

Tribology—the study of the wear of materials due to friction and other factors.

Surface science/catalysis—interaction of materials and structures between solid-gas, solid-liquid or solid-solid interfaces.

Ceramography—the study of the microstructures of high-temperature materials and refractories, including structural ceramics such as RCC, polycrystalline silicon carbide and transformation toughened ceramics.

(*21*) ___________ science—the study of any non-crystalline material including inorganic glasses, vitreous metals, and non-oxide glasses.

Forensic materials engineering—the study of material failure; etc.

Materials science also study:

Polymer properties, synthesis and characterization, for a specialized understanding of how polymers behave, how they are made, and how they are (*22*) __________.

Biomaterials, physiology, biomechanics, biochemistry, for a specialized understanding of how materials integrate into biological systems, e.g. through materiomics.

Semiconductor materials and semiconductor devices, for a specialized understanding of the advanced processes used in (*23*) __________ (e.g. crystal growth techniques, thin-film deposition, ion implantation, photolithography), their properties, and their integration in electronic devices.

Alloying, corrosion, thermal or mechanical processing, for a specialized treatment of metallurgical materials—with applications ranging from aerospace and industrial equipment to the civil industries, etc.

3. PROPERTIES OF MATERIALS

1. Read the text quickly and match the following headings with its parts (1—8).

• Plastic • Brass • Diamond • Metals
• Glass • Iron • Alloys • Cement

2. Read the text again and fill in the gaps with the following words.

1. ____________________

• properties • elements • opaque • chemical
• Periodic • rust • conducts • materials

This (*1*) __________ element is a good conductor of both electricity and heat. In chemistry, this (Ancient Greek *métallon*, μέταλλον) is an element or alloy that (*2*) __________ electricity. In this element, atoms readily lose electrons to form positive ions. Those ions are surrounded by delocalized electrons, which are responsible for the conductivity.

Metals occupy most of the Periodic Table, while non-metallic (*3*) __________ can only be found on the right-hand-side of the (*4*) __________ Table of the Elements. A diagonal line drawn from boron (B) to polonium (Po) separates the metals from the nonmetals. Most elements on this line are metalloids, sometimes called semiconductors. This is due to the fact that these elements have electrical (*5*) ___________ common to both conductors and insulators (elements that don't carry electricity). Elements to the lower left of this division line are called metals, while elements to the upper right of the division line are called (*6*) ___________.

Metals are very corrosive—they (*7*) ___________ in contact with water. Painting (or any other form of covering) is a good way to prevent their corrosion.

Metals in general have high electrical conductivity, the ability to be deformed under stress. Optically speaking, metals are (*8*) ___________ (that means "not clear"), shiny and lustrous. The large number of free electrons in any typical metallic element or alloy is responsible for the fact that they can never be categorized as transparent (*9*) ___________.

2. ______________________

• properties • use • metals • element
• harder • oxygen • rust

This is a metallic chemical (10) ___________ with the symbol Fe (Latin *ferrum*) and atomic number 26. It is a group 8 and period 4 element of the Periodic Table of the Elements and is therefore classified as a transition metal. This element and its alloys (steels) are the most common metals and the most common ferromagnetic materials in everyday (11) ___________. Pure iron is a metal but is rarely found in this form on the surface of the earth because it oxidizes in the presence of (12) ___________ and moisture. Fresh iron surfaces are silvery-grey in colour, but oxidize in air to form a red or brown coating of ferric oxide or (13) ___________. Pure single crystals of iron are soft (softer than aluminium). The (14) ___________ of iron can be modified by alloying it with various other (15) ___________ to form steels. Alloying iron with appropriate small amounts (up to a few per cent) of other metals produces steel, which can be 1,000 times (16) ___________ than pure iron. Iron is a necessary element used by almost all living organisms.

3. ______________________

• characteristics • alloys (×2) • proportion • practical
• elements • provide • harder • electrical

This is a mixture of two or more (*17*) ___________ in which the major component is a metal. Most pure metals are too soft or chemically reactive for (*18*) ___________ use. Combining different ratios of metals as alloys modifies the properties of pure metals to produce desirable (*19*) ___________. The aim of making alloys is generally to make them less brittle, (*20*) ___________, resistant to corrosion, or have a more desirable colour. Of all the metallic (*21*) ___________ in use today, the alloys of iron (steel, stainless steel, cast iron, tool steel, alloy steel) make up the largest (22) ___________ both by quantity and commercial value. Iron alloyed with various proportions of carbon gives low, mid, and high carbon steels. The addition of silicon will produce cast irons.

Other significant metallic alloys are those of aluminium, titanium, copper, and magnesium. Copper alloys have been known since prehistory—bronze gave the Bronze Age its name—and have many applications today, most importantly in (*23*) ___________ wiring. The (*24*) ___________ of the other three metals have been developed relatively recently; due to their chemical reactivity they require electrolytic extraction processes. The alloys of aluminium, titanium, and magnesium are valued for their high strength-to-weight ratios; magnesium can also (*25*) ___________ electromagnetic protection. These materials are ideal for situations where high strength-to-weight ratio is more important than material cost, such as in aerospace and some automotive applications.

Alloys specially designed for highly-demanding applications, such as jet engines, may contain more than ten elements.

4. ________________________

• copper • properties (×2) • colour • shape
• decoration • 16th • brass • instruments • mirror

This is an alloy of copper and zinc. The proportions of zinc and copper can be varied; this creates a range of brasses with various (*26*) ___________. In comparison, bronze is principally an alloy of copper and tin. Brass is a substitutional alloy. It is used for (*27*) ___________ for its bright gold-like appearance; for applications where low friction is required such as locks, gears, bearings, doorknobs, ammunition, and valves; for plumbing and electrical applications; and extensively in musical (*28*) ___________ such as horns and bells for its acoustic (*29*) ___________. It is also used in zippers. Because it is softer than most other metals in general use, brass is often used in situations where it is important that sparks not be struck, as in fittings and tools around explosive gases.

Brass has a yellow (*30*) ___________, somewhat similar to gold. It is relatively resistant to tarnishing, and is often used as decoration and for coins. In antiquity, polished brass was often used as a (*31*) ___________.

Forms of brass have been in use since prehistory. But the direct alloying of (*32*) ___________ and zinc metal was introduced to Europe in the (*33*) ___________ century.

Brass has good malleability (it means it is easy to shape) and acoustic properties, as it was mentioned above. It is used in many musical instruments, such as trombone, tuba, trumpet, cornet, euphonium, tenor horn, and the French horn. Even though the saxophone is classified as a woodwind instrument and the harmonica is a free reed aerophone, both are also often made from brass. In organ pipes of the reed family, brass strips (called tongues) are used as the reeds, which beat against the shallot (or beat "through" the shallot in the case of a "free" reed).

Brass has higher malleability than copper or zinc. The relatively low melting point of brass (900 to 940°C, depending on composition) and its flow characteristics make it a relatively easy material to (*34*) ___________. By varying the proportions of copper and zinc, the properties of the (*35*) ___________ can be changed, allowing hard and soft brasses.

Today almost 90% of all brass alloys are recycled.

Aluminium makes brass stronger and more corrosion-resistant. Aluminium also causes a highly beneficial hard layer of aluminium oxide (Al_2O_3) to be formed on the surface that is thin, transparent and self-healing. Tin has a similar effect and finds its use especially in sea water applications (naval brasses). Combinations of iron, aluminium, silicon, and manganese make brass wear and tear resistant.

5. ______________________

• properties • Diamond • characteristics
• industrial • electrical • tools • natural

This (from the Ancient Greek αδάμας (adámas)—"unbreakable") is an allotrope of carbon. It is less stable than graphite, but the conversion rate from diamond to graphite is negligible at ambient conditions. (*36*) ___________ has the highest hardness and thermal conductivity of any bulk material. Those properties determine the major (*37*) ___________ application of diamond in cutting and polishing (*38*) ___________.

This material has remarkable optical (39) ___________. Combined with wide transparency, this results in the clear, colourless appearance of most natural diamonds. Diamond also has relatively high optical dispersion, that is ability to disperse light of different colours, which results in its characteristic luster. Excellent optical and mechanical (*40*) ___________, combined with efficient marketing, make diamond the most popular gemstone.

Diamond is the hardest (*41*) ___________ material known, where hardness is defined as resistance to scratching and is graded between 1 (softest) and 10 (hardest) using the Mohs scale of mineral hardness. Diamond has a hardness of 10 (hardest) on this scale. Diamond's hardness has been known since antiquity and is the source of its name. Diamond hardness depends on its purity.

Other specialized applications also exist or are being developed, including use as semiconductors: some blue diamonds are natural semiconductors, in contrast to most diamonds, which are excellent (*42*) ___________ insulators.

6. ______________________

• production • non-hydraulic • mixed
• important • building • join • construction

This is a substance which can be (*43*) ___________ with water and become hard after drying. The term "cement" refers only to the dry powder substance. After the addition of water the cement mixture is referred to as "concrete". Cement (mixed with water) can (*44*) ___________ other materials together.

The word "cement" traces to the Romans, who used the term *opus caementicium* to describe (*45*) ___________ which was made from crushed rock with burnt lime as binder. Cements used in construction are characterized as hydraulic or (*46*) __________.

The most (*47*) __________ use of cement is the (*48*) __________ of a strong (*49*) __________ material.

7. ______________________

• optical • windows • breaks • industry
• laboratory • important • suitable

This is an amorphous (non-crystalline) solid material. It (*50*) __________ easily, and is often optically transparent (or clear). It is commonly used for (*51*) __________, bottles, modern hard drives, eyewear, etc. The word "glass" developed in the late Roman Empire. It was in the Roman glassmaking centre at Trier (now it is in modern Germany), that the late-Latin word *glesum* referred to a transparent substance. Glass plays an (*52*) __________ role in science and (*53*) __________. The (*54*) __________ and physical properties of glass make it (*55*) __________ for applications such as flat glass, container glass, optics and optoelectronics material, (*56*) __________ equipment, etc.

8. ______________________

• process • plastic • improve • classifications
• London • products • chemical

It is the general common term for a wide range of synthetic or semisynthetic organic amorphous solid materials used in the manufacture of industrial (*57*) __________. This material is typically a polymer of high molecular mass, and may contain other substances to (*58*) __________ production, the quality of products and/or reduce costs. Monomers of plastic are either natural or synthetic organic compounds.

The word is derived from the Greek πλαστικός (plastikos) meaning "suitable for moulding", and πλαστός (plastos) meaning "moulded". The first human-made (*59*) __________ was invented by Alexander Parkes in 1855; he called this plastic Parkesine (later called celluloid). It was demonstrated at the 1862 Great International Exhibition in (*60*) __________.

The common word "plastic" (as a noun) should not be confused with the technical adjective "plastic" which is applied to any material which undergoes a permanent change of shape (plastic deformation) when strained beyond a certain point. Aluminium, for instance, is plastic in this sense, but not a plastic in the common sense; in contrast, in their finished forms, some plastics will break before deforming and therefore are not plastic in the technical sense.

Plastics can be classified by (*61*) ___________ structure. Some important groups in these (*62*) ___________ are the acrylics, polyesters, silicones, polyurethanes, and halogenated plastics. Plastics can also be classified by the chemical (*63*) ___________ used in their synthesis, such as condensation, polyaddition and cross-linking.

• glass • traditional • properties • shape
• classified • rust • bottles • manufacturing

Other classifications are based on qualities that are relevant for (*64*) ___________ or product design. Examples of such classes are the thermoplastic and thermoset, elastomer, structural, biodegradable, and electrically conductive. Plastics can also be (*65*) ___________ by various physical (*66*) ___________, such as density, tensile strength, glass transition temperature, and resistance to various chemical products.

Plastics show good plasticity during manufacture; that allows them to be pressed, or shaped into a variety of forms—such as films, fibres, plates, tubes, (*67*) ___________, boxes, and much more. Plastic has relatively low cost; it is easy to (*68*) ___________; it doesn't (*69*) ___________ in contact with water. That is why plastics are used in different products—from paper clips to spaceships. They have already displaced many (*70*) ___________ materials, such as wood, stone, horn and bone, leather, paper, metal, (*71*) ___________ and ceramic (in most of their former uses). But plastics are still too expensive to replace items like ordinary buildings, bridges, dams, pavement, and railway ties.

3. **Make a summary of this text. (List the materials mentioned and their main properties.)**
4. **Try to make your own small text about properties of *wood*, *gold* (or any other material of your choice).**

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_4/)

1. MATERIALS SCIENCE CENTRE—WHAT DOES IT DO? (02:17)

Pre-listening

1. *What do material engineers do in their career?*
2. *What do you think is the aim of a Material Science Centre?*
3. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*

   Research, equipment, capability.

While-listening

Watch the video **part by part** and answer the following questions.

00:05—00:24

4. *What is Materials Science Centre?*
5. *What does the Centre do?*

00:25—00:37

6. *What is the equipment the speaker is talking about used for?*

00:38—00:45

7. *What kind of equipment does the Centre have?*

00:46—01:00

8. *How many universities in America have special equipment (or instruments for research) that the speaker is talking about?*

01:11—01:41

9. *What capabilities do these special instruments have?*

Post-listening

10. *Do you think that people need to have such scientific centres? Why?*

2. MATERIALS SCIENCE AND ENGINEERING AT CLEMSON GRADUATE SCHOOL (02:50)

Pre-listening

1. *What does materials science deal with?*
2. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*

   To direct (= to be the head of), faculty, equipment, microscope, to depend on.

While-listening

Watch the video **part by part** and answer the following questions.

00:00—01:36

3. *What is the speaker's name?*
4. *What does the speaker do?*
5. *What is studied at this school?*
6. *What practical things do they do at this school?*
8. *What faculty is mentioned in the track?*

01:37—end

9. *Where is the speaker?*
10. *What equipment is the speaker talking about?*
11. *Does the school have only one microscope?*
12. *What does the usage of different microscopes depend on?*

Post-listening

13. *Who do you think will be interested in being a student at this school? Why?*

3. MATERIALS SCIENCE AND ENGINEERING AT PENN STATE (08:40)

Pre-listening

1. *What does materials science deal with?*

2. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*

   Simplified, to apply something, to manipulate, impact.

While-listening

Watch the video **part by part** and answer the following questions.

00:00—00:27

3. *What is the main idea of this short introduction?*

00:28—00:52

4. *What is the most simplified definition of materials science?*
5. *Who is the speaker and what does he do?*
6. *What does the materials science study according to the speakers?*

   The 1st speaker: ___________
   The 2nd speaker: ____________
   The 3rd speaker: ____________

00:53—04:33

7. *What are the spheres of usage of materials science research that are mentioned in this part of video?*
8. *What do they study and do on practice at Penn State?*

04:34—05:10

9. *What is the idea of interdisciplinary learning?*

Post-listening

10. *Summarize the ideas of what materials science is, what it deals with, what it studies and why.*

5. SMART MATERIALS

Part I

1. **Read the following sentences. What does the word "smart" mean in each one (clever, fashionable, formal)?**
   1. He wore a *smart* suit to the meeting.
   2. She's the *smartest* girl in the class.
   3. They stayed in a *smart* hotel in New York.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 6*, *pg. 7*, *Ex. 1.*)

2. **(a) Look at the title of the text. Do you think the materials are clever, fashionable, or formal?**
   (b) Read the text and check.

SMART MATERIALS

Smart—or shape memory—materials are an invention that has changed the world of engineering. There are two types: metal alloys and plastic polymers. The metal **alloys** were made first and they are usually an expensive mixture of titanium and nickel.

Shape memory materials are called "smart" because they **react** to changes in their **environment**, for example:
— plastics that return to their **original** shape when the temperature changes. One use is in surgery where plastic threads "remember" the shape of a knot, react to the patient's body temperature and make themselves into stitches;
— metal alloys that have a "memory" and can return to their original shape. They are used in medical **implant**s that are

compressed so they can be put inside the patient's body through a small cut. The implant then **expand**s back to its original shape. More everyday uses are for flexible spectacle frames and teeth braces;
— solids that darken in sunlight, like the lenses in some sunglasses;
— liquid crystals that change shape and colour. These have been used in climbing ropes that change colour if there is too much strain and weight on them.

The future of these materials and their possible uses is limited only by human **imagination**. One clever idea is that if cars were made of smart metal, a minor accident could be repaired by leaving the car in the sun!

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 6*, *pg. 7*, *Ex. 2.*)

3. Find in the text.

Появились первыми; дорогостоящая (смесь); изначальная форма; температура человеческого тела; помещать внутрь; небольшой надрез; возможные способы использования; человеческое воображение; незначительное повреждение.

4. Read the text again and choose the correct endings.

1. Smart materials change when
   (a) the weather changes.
   (b) something affects them.
   (c) the light is switched on.
2. Plastic threads are used for
   (a) sewing.
   (b) stitching.
   (c) knitting.
3. Medical implants made from shape memory alloys are good because
   (a) they save lives.
   (b) they change colour.
   (c) they are easy to put in.
4. Climbing ropes with liquid crystals change colour to

(a) warn you.
(b) amuse you.
(c) make you heavy.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 6*, *pg. 7*, *Ex. 3.*)

5. Complete the definitions with the words in bold type in the text.

1. An ___________ is something medical that is put inside the body, for example, a heart valve.
2. You need a good ___________ to think of new and interesting ideas.
3. The “___________” means the first or earliest.
4. ___________ are materials made from mixing two metals.
5. To “___________” means to become bigger.
6. To “___________” means to change because something else happens.
7. The ___________ is everything around a person or thing.
8. To “___________” means to make smaller.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 6*, *pg. 7*, *Ex. 4.*)

6. Answer the following questions to the text.

1. How many types of smart materials are there?
2. Which type appeared first?
3. Why are metal alloys expensive?
4. Why do these materials change their shape?
5. What does medicine use these materials for?
6. What are the spheres these materials widely used in?
7. Why are these materials called “smart”?

7. Match the following words.

• implant • imagination • body • alloys • mixture
• shape • materials (×2) • inside • uses

1	patient’s		6	metal	
2	shape memory		7	possible	
3	put		8	original	
4	expensive		9	medical	
5	human		10	smart	

8. Fill in the gaps in the following sentences with suitable words.

1. Brass is an ________________ of copper and zinc.
2. Brass doesn't _______________ to water.
3. Smart materials can return to their __________________ shape.
4. Metals ________________ when they are heated.
5. _______________________ is the ability to create pictures in your mind.
6. Smart materials are called so, because they react to changes in their __________________.
7. Medical ________________ is usually _________________ and put inside the patient's body.
8. Bricks are hold together with the help of a ________________ of cement and water.
9. Smart materials have good shape __________________.
10. "Smart materials" is the human ___________________ of the 20th century.

Check the knowledge of active vocabulary from this part with the help of "ACTIVE VOCABULARY" section.

Part II

1. SMART MATERIALS (1)

Read the text and fill in the gaps with the following words.

• temperature •materials •types
•magnetic •properties

Smart materials are (*1*) ___________ that have one or more (*2*) ___________ that can be significantly changed in a controlled manner by external stimulation, such as stress, (*3*) ___________, moisture, pH, electric, or (*4*) ___________ fields.

There are different (*5*) ___________ of smart materials, some of which are already common. Some examples are as following:

• environment • produce • changes
• field • from • shape

— **Piezoelectric** materials are materials that (*6*) ___________ a voltage when stress is applied. Suitably designed structures made (*7*) ___________ these materials can bent, expand, or contract when a voltage is applied.
— **Shape memory alloys** and **shape memory polymers** are thermoresponsive materials where deformation can be seen in case of temperature (*8*) ___________.
— **Magnetic shape memory** alloys are materials that change their (*9*) ___________ in response to a significant change in the magnetic (*10*) ___________.
— **pH-sensitive polymers** are materials which collapse when the pH of the (*11*) ___________ changes.
— **Temperature-responsive polymers** are materials whose changes depend on temperature.

• pressure • metal • opacity • colour
• sunlight • response • electrical

— **Halochromic** materials are commonly materials that change their colour as a result of changing acidity. One suggested application is for paints that can change (*12*) ___________ to indicate corrosion in the (*13*) ___________ underneath them.

— **Chromogenic systems** change colour in response to (*14*) ___________, optical or thermal changes. These include electrochromic materials, which change their colour or (*15*) ___________ on the application of a voltage (e.g. liquid crystal displays), thermochromic materials change in colour depending on their temperature, and photochromic materials, which change colour in response to light, for example, light sensitive sunglasses darken when used in bright (*16*) ___________.
— **Non-Newtonian fluid** is a liquid which changes its viscosity in response to an applied shear rate (to shear = to become twisted or break under pressure). In other words the liquid will change its viscosity in (*17*) ___________ to some sort of force or (*18*) ___________.
— **Ferrofluid.**
— **Photomechanical materials** change shape under exposure to light.

2. SMART MATERIALS (2)

Read the text and fill in the gaps with the following words.

• solid • design • alloys • changed • special
• shape • technology • properties • type • smart

Science and (*1*) ___________ have made amazing developments in the (*2*) ___________ of electronics and machinery using standard materials, which do not have particularly (*3*) ___________ properties (i.e. steel, aluminum, gold). Imagine the range of possibilities, which exist for special materials that have properties scientists can manipulate. Some such materials have the ability to change (*4*) ___________ or size simply by adding a little bit of heat, or to change from a liquid to a (*5*) ___________ almost instantly when near a magnet. These materials are called (*6*) ___________ materials.

Smart materials have one or more properties that can be changed. Most everyday materials have physical (*7*) ___________, which cannot be significantly altered; for example, if oil is heated, it will become a little thinner, whereas a smart material with variable viscosity may turn from a fluid which flows easily to a solid. Different smart materials already exist and are being researched extensively. These include piezoelectric materials, magneto-rheostatic materials, electro-rheostatic materials, and shape memory (*8*) __________. Some everyday items are already incorporating smart materials (coffee pots, cars, the International Space Station, eyeglasses) and the number of applications for them is growing steadily.

Each individual (*9*) __________ of smart material has a different property which can be significantly altered, such as viscosity, volume, and conductivity. The property that can be (*10*) __________ influences what types of applications the smart material can be used for.

3. SHAPE MEMORY ALLOYS (SMA)

1. Read the text and choose the best heading to each part.

A. Applications of Shape Memory Alloys.
B. What Are Shape Memory Alloys?
C. Advantages and Disadvantages of Shape Memory Alloys.

1. ______________________________

Shape memory alloys (SMAs) are metals, which exhibit two very unique properties, *pseudo-elasticity* and *the shape memory effect*. Arne Olander first observed these unusual properties in 1938, but not until the 1960s were any serious researches made in the field of shape memory alloys. The most effective and widely used alloys include NiTi (nickel—titanium), CuZnAl, and CuAlNi.

2. ______________________________

The unusual properties mentioned above are being applied to a wide variety of applications in a number of different fields. The shape memory effect is currently being implemented in:

— coffee pots;
— the space shuttle;
— thermostats;
— hydraulic fittings (for airplanes).

Some examples of applications in which pseudo-elasticity is used are:
- — eyeglass frames;
- — bra underwear;
- — medical tools;
- — cellular phone antennae;
- — orthodontic arches.

3. ______________________________

Some of the main advantages of shape memory alloys include:
- — biocompatibility;
- — diverse fields of application;
- — good mechanical properties (strong, corrosion resistant).

There are still some difficulties with shape memory alloys that must be overcome before they can be used up to their full potential. These alloys are still relatively expensive to manufacture and machine compared to other materials such as steel and aluminum. Most SMAs have poor fatigue properties; this means that while under the same loading conditions (i.e. twisting, bending, compressing) a steel component may survive for more than one hundred times more cycles than a SMA-element.

2. Answer the following questions.

1. How many unique properties have the SMAs got?
2. What are they?
3. How long is the history of SMAs?
4. What are the most famous alloys?
5. What property of SMAs is mostly used in medicine?
6. What are the advantages of the SMAs?
7. What are the disadvantages of the SMAs?

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_5/)

1. SHAPE MEMORY EFFECT
(00:26)

Pre-listening

1. *Do you know the following words?*

   Wire, ice, to heat, to cool, hot, flame, soft, deformable.

While-listening

Watch the video and answer the following questions.

2. *What is the wire made of?*
3. *Why is it called smart?*
4. *How many stages can you divide the process on the video into?*
5. *Complete the following sentences about each stage of the process on the video.*
   - (a) We ___________ the wire with ___________.
   - (b) The wire ___________ soft and easily ___________.
   - (c) We heat the ___________ with a ___________.
   - (d) The ___________ turns to its ___________ shape.

Post-listening

6. *Think of when and where this wire can be used.*

2. SMART ___________
(00:33)

Watch the track and answer the questions.

1. *What type of "smart" material is it about? Complete the heading.*
2. *Why is it called "smart"?*
3. *What do you need to do to change the colour of the glass?*
4. *How can people use this "smart" glass?*

3. FASHION METAMORPHOSIS (02:30)—video, inscriptions

Pre-listening

Think on the following.

1. *What do we mean when we think about fashion?*
2. *What connection may there be between fashion and smart materials? How can smart materials be used in fashion?*

While-listening

3. *Watch the video, read, and understand the inscriptions.*

Post-listening

4. *Which do you think is the most useful usage of smart materials?*
5. *What sphere would you invest in to organize future researches and why?*

4. MATERIALS ENGINEERING (01:53)

Pre-listening

1. *What do materials engineers do in their career?*
2. *Why is it important to study the properties of materials?*
3. *Do you know the following words? Can you guess the meaning of any of them? Study the meaning of the words.*

   Alloy, shape memory alloy, green-energy, to reduce, pollution, surgery, research, to collaborate.

While-listening

Watch the video **part by part** and answer the following questions.

00:08—00:21

4. *Who is the speaker and what does he do?*

00:22—00:31

5. *What exactly does he study?*
6. *Who finances this project?*

00:32—00:42

7. What properties do these materials have?

00:43—00:52

8. Where can these materials be used?

00:53—00:58

9. Are scientists from other countries also interested in this project?

00:59—01:05

10. What university does Boise State University collaborate with?

01:06—01:20

11. Where can these results be found?

12. What does "NSF" mean?

01:21—end

13. What does the speaker "do"?

14. Why does he do this research?

15. What happens when he enters the lab?

16. What does "research" mean according to this student?

Post-listening

17. Make a summary of the video track.

6. TECHNICAL DRAWING

Part I

1. **Put the following words in the correct order and read the sentence. How do you understand it? Do you agree to this statement?**

   • worth • is • picture • a thousand • A • words

2. **Read the following text and think of a title to it.**

   A. In the past, technical drawings for industry and architecture were drawn by hand, i.e. people worked at drawing boards with drawing equipment. These **hand-drawn** diagrams provided clear technical information but were slow and expensive to make. Nowadays working drawings are done on computers, which is much quicker.

   B. Computers can also:
   1. save, change, and **recycle** the drawings;
   2. make 3D images;
   3. make drawings bigger or smaller;
   4. keep an electronic library of standard parts;
   5. Make **symmetrical images** of components;
   6. make **accurate** and **consistent** drawings.

   C. A good way to explain the advantages is to think about architectural drawing. Features such as windows and doors can be moved until the **architect** likes the building. Images of the rooms are created in 3D so the **viewer** can "walk" through the rooms. Designers can also experiment with different arrangements of furniture and colours.

   ("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 7*, *pg. 8*, *Ex. 4*.)

3. Read the text again and find the English equivalents to the following expressions.

Чертежи; вручную; обеспечивали ясность проекта; дорогостоящий; зеркальные отражения; составные части; преимущества; экспериментировать с; подбор мебели и цвета.

4. Read the text again and choose the correct answers to the questions below.

1. What is the text about?
   (a) Computer-assisted design.
   (b) Working with computers.
2. What is paragraph A about?
   (a) The history and future of CAD systems.
   (b) The connection between technical drawing and CAD.
3. What is paragraph B a list of?
   (a) The problems of using computers in design.
   (b) The advantages of using computers in design.
4. What does paragraph C describe?
   (a) How CAD is used in designing machines.
   (b) How CAD is used in designing homes.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 7*, *pg. 8*, *Ex. 5.*)

5. Read paragraph B again. Match each point (1–6) in the text with a benefit from the list below.

(a) You can draw 50%, then make a mirror image.
(b) You don’t waste time drawing things again and again.
(c) You make fewer mistakes.
(d) You see the finished shape in 3D.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 7*, *pg. 8*, *Ex. 6.*)

6. Try to explain why the word “walk” is in inverted commas (“ ”) in paragraph C.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 7*, *pg. 8*, *Ex. 7.*)

7. Complete the definitions below with the words in bold type in the text.

1. “____________” means having two halves the same shape and size.

2. "____________" means made by a person.
3. "____________" means to use something again.
4. A ____________ is a person looking at something.
5. "____________" means correct in every detail, with no mistakes.
6. ____________ are pictures or drawings.
7. An ____________ is a person who designs buildings.
8. "____________" means always the same.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 7*, *pg. 8*, *Ex. 9.*)

8. Match the words with their definitions.

• image • architect • hand • to save • symmetrical
• equipment • viewer • advantage • designer • to recycle
• drawing board • drawing • to provide

1	To do something with objects in order to use them again; we do this with plastic bottles, cans, etc.	
2	Art of representing objects by lines with a pencil, chalk, etc.	
3	Mental picture or idea created in your mind; a copy or a picture of a person.	
4	To keep something safe (money, information, reputation).	
5	Everything you need for a particular purpose, job, task (modern, office, medical, engineering).	
6	A part of your body at the end of your arm which has five fingers.	
7	To give something to somebody physically or virtually (the answer, a solution).	
8	A big flat board to which a paper is fixed on which a drawing is made.	
9	Pluses of something over something.	
10	A person who creates images, drawings.	
11	A person who designs buildings.	
12	When two halves (parts) of an object are the same size and shape.	
13	A person who is looking at something or watching something.	

9. Make as more word phrases with the words in (a) as you can. Do the same with the words in (b).

(a)

• provide • image • information • hand • drawing
• expensive • to save • engineer • advantage • technical
• clear • drawn by • equipment • symmetrical

(b)

• accurate • experiment • drawing board • to provide
• to work at • advantage • expensive • components • symmetrical
• architect • image • by hand • to change • to draw • information
• drawing • viewer • quipment • technical

10. Translate the following sentences into Russian. Translate the idea, not word for word.

hand, to hand

1. The letter was brought *by hand*.
2. She *handed* the drawing to the boss.
3. The original plan was drawn *by hand*.
4. It's slow and expensive to make technical drawings *by hand*.

drawing

5. He made a *drawing* of the object.
6. She is good at *drawing*.
7. He is interested in technical *drawing*.
8. Nowadays technical *drawings* are done on computers.

technical

9. He has got *technical* education.
10. You should have *technical* qualification if you want to get this job.
11. He visited some *technical* classes last year but didn't get any certificate.
12. Would you like to enter a *technical* college?
13. The train came late because of some *technical* problems.

equipment

14. We have already got all the necessary *equipment*.
15. To fulfil this task we need some special *equipment*.

16. What is basic drawing *equipment*?
17. This company provides good electrical *equipment*.

provide

18. The management will *provide* your group with food and drink.
19. Workers at factories are *provided* with tools.
20. Equipment has already been *provided*.
21. The group of young engineers has *provided* the company with a clear and reasonable solution.
22. Students are *provided* with course-books.

save

23. Please *save* this document in my folder.
24. All important information should be *saved*.

recycle

25. We can *recycle* plastic bottles and cans.
26. The process of *recycling* is rather complex.

symmetrical

27. Please make a *symmetrical* image of this object.
28. Try to make this drawing more *symmetrical*.

image

29. The *image* of this new car is wonderful!
30. We need to make a 3D *image* of this object.

Check the knowledge of active vocabulary from this part with the help of “ACTIVE VOCABULARY” section.

Part II

1. TECHNICAL DRAWING

Read the text and fill in the gaps with the following words.

• technical drawing • discipline • clearly
• technical drawings • graphic communication
• provides • idea • drafter • drawing
• Computer-Aided Design • engineering drawing
• design engineers • form

Technical drawing is the (*1*) ___________ of creating standardized (*2*) ___________ by architects, CAD drafters, (*3*) ___________, and other professionals. Technical drawing includes the various fields and technologies (such as electronics), which has in turn revolutionized the art with new tools in the form of (*4*) ___________. This system is known as CAD.

A technical drawing or (*5*) ___________ is a type of (*6*) ___________ and form of (*7*) ___________, used in the transforming of an (*8*) ___________ into physical (*9*) ___________. This type of drawing is used to fully and (*10*) ___________ define requirements for engineered items, and is usually created in accordance with standardized conventions for layout, nomenclature, interpretation, appearance (such as typefaces and line styles), size, etc.

The process of creating a technical drawing is called drafting. A person who does drafting is known as a (*11*) ___________. Sometimes this person is called a drafting technician or a draftsperson. A (*12*) ___________ differs from a common drawing by how it is interpreted. A common drawing can hold many purposes and meanings, while a technical drawing (*13*) ___________ a clear understanding of all specifications of an object or objects.

2. COMPUTER-AIDED DESIGN (CAD)

Read the text and fill in the gaps with the following words.

• product • computer technology
• communication• two dimensions • Drafting
• three dimensions • Computer-Aided Design
• engineering • improve • drawings • drawn

Today, the mechanics of drafting has largely been automated and accelerated through the use of (*1*) ___________ systems. Computer-aided design is the use of (*2*) ___________ in order to (*3*) ___________ the design of a (*4*) ___________. It is both a visual (drawing) and symbol-based method of (*5*) ___________ among professionals.

(*6*) ___________ can be done in two ways: (*7*) ___________ and (*8*) ___________, known as 2D and 3D. Drafting is not only the way of communication by technical or (*9*) ___________ drawings but is also the industrial art. In representing complex, three-dimensional objects in two-dimensional (*10*) ___________, these objects have traditionally been (*11*) ___________ by three projected views at right angles.

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_6/)

1. BASIC DRAWING BOARD TECHNIQUES (02:37)

Pre-listening

1. *Do you know these words?*

    Label, heading, capital letter (capitals).

2. *What drawing equipment do you know?*

While-listening

Listen to the whole text without video, do the following assignment, and answer the following question.

3. *The text is:*
    (a) a list of drawing equipment;
    (b) instructions on basic drawing;
    (c) history of drawing.
4. *How many parts can you divide the text into?*

Listen to **the parts** of the text and answer the following questions.

00:00—00:22

5. *What equipment is mentioned in the text?*
    What equipment is mentioned in the text but wasn't mentioned by you in "2" and vice versa?
    Can you guess what the word "compass" means?

00:22—end

6. *What do the following figures mean? Match the figures with the following words.*

    5 mm, 10 mm, 2H, 45°, 30/60°
    labels, set square, pencil, headings, set square.

Listen and watch the video, check your answers.

7. *Fill in the gaps in the following text.*

(*1*) ___________________________ Technique

For this type of drawing you need the following (*2*) __________: a sharp 2H (*3*) __________; and a (*4*) __________ degree set square. You'll also need a 30/60 degree set square and a (*5*) __________.

Using the (*6*) __________:

Make sure you put squares against the board, you can now (*7*) __________ using your (*8*) __________ and slide up and down across the (*9*) __________, you can flip your set square to get the desired angle.

Labels and (*10*) __________:

The conventions we (*11*) __________ are as follows: our labels are (*12*) __________ mm high. We usually draw a 5 mm high guide line, measure it carefully, so it is 5 mm high, not 7 or (*13*) __________.

We use only (*14*) __________ without exception. I'm now going to put the (*15*) __________ down to show you the lettering that we use. We use plain, straightforward lettering.

Whereas our labels are 5 mm high, headings could be up to (*16*) __________ mm.

Post-listening

8. *What do the following words mean? Try to explain on your own.*

   Compass, set square, to slide up and down.

9. *What are basic rules of drawing?*

7. INDUSTRIAL PRODUCTION

Part I

Section A

1. **Have you ever visited a factory? Did you find out anything interesting there?**
2. **Read the following text. What is the name of the company?**

A FACTORY TOUR

1. "Good morning. I'd like to start by welcoming you and your teacher to FK Industries.

2. The purpose of today's visit is to show you our new CAM or CNC system. As I expect you all know, CAM means "Computer-Assisted Manufacturing" and CNC is "Computer Numerical Control". Before I show you that system, I'll just remind you what the two earlier stages in the process are: one, developing the design and two, the prototype model. When we've completed these two stages, the next step is to start making the items so we can start selling them.

3. Our CNC system takes the information from the CAD (Computer-Assisted Design) system and gives it to the lathes in the factory. The system can be used for other types of machines but we use lathes so that is what you'll see today.

4. Before we start our tour of the factory, I'll tell you what I think the main advantages of CNC are: human error is reduced, the machines always work in the best way because they adjust their settings automatically and, of course, every component produced is identical. Maybe you'll think of some more advantages as we walk through the factory.

5. As we walk through the factory, please, stay with the group and walk behind the yellow lines on the floors. The tour takes about thirty minutes and there will be time for questions at the end of the tour. So, if you'll follow me, we'll start."

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 8*, *pg. 9*, *Ex. 2.*)

3. Read the text again and decide if the sentences below are true (T) or false (F).

The speaker ...

1	is a teacher.	T	F
2	is talking about a factory system.	T	F
3	is talking about jobs in the factory.	T	F
4	is talking to other engineers.	T	F
5	is talking to students.	T	F
6	is a worker in the factory.	T	F

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 8*, *pg. 9*, *Ex. 2.*)

4. Read the text again and match the paragraphs (1–5) with the topics (A–E) below.

A	Background information	
B	Rules for the factory visit	
C	Benefits of the system	
D	Welcome	
E	Basic information about their system	

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 8*, *pg. 9*, *Ex. 3.*)

5. Read the text again and write short answers to the following questions.

1. Are CAM and CNC the same?
2. Is manufacturing the second stage in the process?
3. Can CNC operate other machines?
4. Does the speaker like the system?
5. When will he/she answer the students' questions?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 8*, *pg. 9*, *Ex. 4.*)

6. Read the text again and answer the following questions.

1. Where are the people?
2. Who is speaking?
3. Who is the speaker talking to?
4. What is the speaker talking about?
5. What is the purpose of the tour?
6. What is the name of the factory?
7. What are the stages of the process?
8. How does the system work?
9. What are the advantages of the system?
10. What are the rules of visiting the factory?
11. Why are these rules important?
12. How long is the tour?
13. Do you think there will be questions?
14. What questions may students ask?

7. Find the mistakes in spelling of the following words and correct them. Only one word is correct.

Numerikal; eror; backgraund; advantege; pupose; reduse; rule; instraction; misteik; benifit.

8. Match the words that are close to each other in their meaning. Use the glossary or your dictionary to help you.

• education • rule • numerical • to minimize • error • aim
• background • digital • advantage • purpose • to reduce
• benefit • instruction • to rule • mistake • to control

9. Match the following words to make phrases:

• risk • background • digital • information • numerical
• rules • benefits • instruction • to reduce • important
• control • television • for workers • of the project

10. Guess the word from its explanation.

1. Detailed information on how to do something or use something.
2. When you get an easier question to answer during the exam than your groupmate, it means you have a(n) ... (over him).
3. A computer system that helps people operate machines (engines) and control industrial process.

4. Details of something (event, situation); additional information.
5. When you have a better qualification than another person and you both want to get one and the same job.
6. When you have written or pronounced a word not correctly, your teacher says: “It is a ...” (or: “You have done a ...”).
7. When you do something wrong and a computer can’t fulfil your command, it shows you a box with this word.
8. Details of your family life.
9. Nowadays we have this kind of TVs, photo cameras, video cameras. They produce a better image.
10. It means “to make something less in quantity”, to minimize.

11. Find the words from the text and exercises in the following table (7 words). They may be written diagonally, horizontally or vertically.

	a	b	c	d	e	f	g	h	i	j
1	B	A	C	E	R	R	O	R	Q	R
2	A	J	L	P	U	R	P	O	S	E
3	C	Q	M	Z	L	M	R	C	G	K
4	K	H	C	W	E	Y	L	A	X	J
5	G	C	W	K	X	A	T	H	F	L
6	R	U	N	B	E	N	E	F	I	T
7	O	R	R	B	A	K	G	J	X	A
8	U	F	Z	V	H	B	H	F	Q	W
9	N	B	D	I	G	I	T	A	L	Z
10	D	A	J	Z	Q	C	K	L	B	W

12. Translate the following sentences into Russian. Translate the idea, not word for word.

rule/instruction; to rule/to control

1. Always read the instructions before you start doing the task.
2. Before using the engine study all the rules.
3. Using an implant has a number of rules.
4. Each university has its own rules of study.
5. Follow all the rules if you want to finish the experiment.
6. The first rule in any interview is to make eye contact with a person.

7. Engineers should know the rules of using engineering equipment.
8. The first rule at our course is not to be late for classes.
9. The main rule of study is to fulfil homework.
10. The golden rule of passing the exam is to study during the term.

benefit/advantage

11. I've got the benefit of good education.
12. The new rules are to everyone's benefit.
13. It will be to your benefit to get this qualification.
14. He can't see the benefit of computer drafting.
15. Implants are good benefit of today's medicine.

background

16. To get this job a person needs an engineering background.
17. Can you give the background of CNC system?
18. Let's have a look at the background of technical drawing.
19. Has he got an architectural background?
20. This student doesn't have any background knowledge about this invention.

Section B

1. Read the text "The Mini story". The three paragraphs are from a newspaper article and one is from a fashion magazine. Which one?

THE MINI STORY

A. There are 2,500 employees at the plant and working environment is good. The car assembly line is designed ergonomically to be easy to use and comfortable for the operators. For example, the car is raised, lowered, and turned through 90 degrees so the workers can do their jobs comfortably and easily. Old-fashioned, noisy, compressed-air tools have been replaced with quieter and more accurate electric tools.

B. The first *Mini* was first made in 1959 and since then over five million people have owned one. BMW, a German car manufacturer, now owns the *Mini* and the newest model is being manufactured at an advanced production system in Oxford, England.

C. During the 1990s approximately £500 million was spent to change an old Oxford car factory into a state-of-the-art manufacturing plant. The Oxford plant now produces around 100,000 *Minis* a year.

D. In Britain in the 1960s the only really cool car was the *Mini*. Everybody wanted one. It starred in advertisements and films and was as famous as the Beatles or the Rolling Stones. Anyone who was young, rich, famous, and fashionable had to be photographed sitting on, in, or just near one. And anyone who was poor, unknown, and not very fashionable wanted one too. There were small and cheap and suited the mood of the post-war generation who had more money and freedom than their parents had ever had.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 9*, *pg. 10*, *Ex. 2.*)

2. Now read the text again and put the paragraphs from the newspaper article in the correct order.

3. Find the following expressions in the text.

Условия труда; для легкого использования; удобно и легко; производитель авто; в год; так же ... как; соответствовали духу послевоенного времени.

4. Find words in the text that mean:

1. employees who work on machines (paragraph A);
2. factory (paragraph C);
3. very modern (a phrase, paragraph C);
4. working conditions (paragraph A);
5. where the cars are put together (two words, paragraph A).

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 9*, *pg. 10*, *Ex. 4.*)

5. Read the text again and answer the questions below.

1. When was the first *Mini* made?
2. Why is the Mini factory in Oxford special?
3. How many new Minis are made each year?
4. How many people work at the Mini factory?
5. Why is the new factory better for the workers?

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 9*, *pg. 10*, *Ex. 5.*)

6. Remember the Passive Voice. Find examples of Passive in the text and complete the table.

	Simple	Continuous	Perfect
Present			
Past			
Future			

7. Match the phrases from columns A, B, C to make sentences about the Mini car plant.

	A	B	C
1	The car	is designed	through 90 degrees.
2	Old-fashioned tools	was made	to change old factory into a modern plant.
3	Near £500 million	is being manufactured	ergonomically.
4	The newest model	was spent	in 1959.
5	Assembly line	have been replaced	in Oxford, England.
6	The first *Mini*	is raised, lowered, turned	with more accurate electronic tools.

8. Read the following sentences and fill in the gaps with the words from modules 1–7.

1. Engineers solve problems in a ___________ way.
2. Engineers use theory to produce ___________ answers.
3. Students spend most of their time in the ___________.
4. Teachers will assess you at the end of a ___________ (a period of six months).
5. You can study these courses full-time or ___________.
6. This ___________ prepares students for jobs in radio and electronic communication.
7. Smart ___________ have changed the world of engineering.
8. Doctors compress ___________ and put them into the patient's ___________.
9. People call shape memory materials "___________".

10. Hand-drawn diagrams provide clear ___________ information.
11. Nowadays engineers create technical ___________ on computers.
12. Computers save, change, and ___________ information.
13. We use computers to make symmetrical ___________ of components.

9. Remember what Passive Voice is. Now change the sentences from Ex. 8 into Passive.

10. Read the sentences and fill in the gaps with the following verbs in Passive.

• make (×4) • compress • call • use (×3) • divide
• base • reduce • repair • spend • do • teach
• limit • draw • mark (assess) • create

Pr.S = Present Simple, P.S = Past Simple, F.S = Future Simple, Pr.P = Present Perfect

1. Everything we use in modern life ___________ by engineers. (Pr.S)
2. The whole science of engineering ___________ into three main areas—civil, mechanical, electrical engineering. (Pr.S)
3. Most of the time ___________ by students doing practical tasks in the workshop. (F.S)
4. Each project ___________ at the end of a term. (Pr.S)
5. All courses ___________ at Technical College. (Pr.S)
6. Selection ___________ on the applicant's work experience and an interview. (F.S)
7. Metal alloys ___________ first. (P.S)
8. Alloys ___________ from titanium and nickel. (Pr.S)
9. Shape memory materials ___________ "smart". (Pr.S)
10. Metal alloys ___________ in medical implants. (Pr.S)
11. Implants ___________ and put into patient's body. (Pr.S)
12. Liquid crystals (as "smart" material) ___________ already ___________ in climbing ropes. (Pr.P)
13. If cars ___________ of smart metal, a minor accident ___________ by leaving the car in the sun. (Pr.S/F.S)
14. The possible uses of smart materials ___________ only by human imagination. (Pr.S)

15. In the past technical drawings ___________ by hand. (P.S)
16. Nowadays working drawings ___________ on computers. (Pr.S)
17. Images of the rooms ___________ in 3D. (Pr.S)
18. CAD ___________ with any kind of machine. (Pr.S)
19. The main advantage of using CNC is that human error ___________. (Pr.S)

Section C

1. **Have you ever heard about a handmade car? Do you know where it is manufactured? How long does it take people to wait to buy it? Read the text "A handmade car" quickly and find the answers to the questions.**
2. **Look at the words below. Check the meaning of them in the glossary or your dictionary.**

• craftsmen • highly-skilled • skills
• traditional • unique

Read the text again and fill in the gaps with the words given above.

A HANDMADE CAR

The *Morgan* is a (*1*) ___________ car: it is made in Britain by a family-owned company and it is handmade.

Each *Morgan* is made individually. Modern materials and up-to-date manufacturing technology are combined with 100-year-old (*2*) ___________. There are no assembly lines because each stage of the manufacturing is done by (*3*) ___________ craftsmen. For example, the wooden frame is made in the same way as the first *Morgan* in 1909, upholsterers make the leather seats, and sheet metalworkers make the panel by hand.

In contrast to all these (*4*) ___________ skills, Morgan engineers make precision mechanical components using modern Computer Numerical Control (CNC) machinery so a *Morgan* driver has a state-of-the-art engine in a traditionally-made car.

It takes a long time to make a car by hand. The Morgan factory produces about 500 cars a year. Buyers put their name on a waiting list and then wait for the factory to tell them that their car is finished. The shortest wait is about two years — and sometimes the wait is five years. Like proud parents-to-be, people on the waiting list can visit the factory to see their car being made and to talk to the (*5*) ___________ doing the work.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 10*, *pg. 11*, *Ex. 2*.)

3. Read the text again and find the equivalents to the following phrases in the text.

Компания семейного бизнеса; современная технология производства; первоклассные мастера; тем же способом; в противовес; суперсовременный двигатель; это занимает много времени; самый короткий срок; будущие родители.

4. Read the text again and decide if the sentences below are true (T) or false (F).

1	The Morgan is made by machines.	T	F
2	Old and new ideas are used to make Morgans.	T	F
3	Morgan cars aren’t made on an assembly line.	T	F
4	Morgan engines are old-fashioned.	T	F
5	You can walk into the Morgan factory, buy a car and drive it home.	T	F

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 10*, *pg. 11*, *Ex. 3*.)

5. Find examples of Passive Voice in the text and complete the table.

	Simple	Continuous	Perfect
Present			
Past			
Future			

6. Match the following words.

• by hand • produced • information • Numerical Control
• ergonomically • environment • Manufacturing
• technology • skills • the company • craftsmen
• information • list • for operators • the system
• model • components • line • use • manufacture

1	background		11	assembly	
2	up-to-date		12	basic	
3	employees of		13	Computer	
4	benefits of		14	easy to	
5	is designed		15	car	
6	highly-skilled		16	mechanical	
7	working		17	comfortable	
8	the newest		18	waiting	
9	Computer Assisted		19	made	
10	are		20	traditional	

7. Read the texts from Section B ("The Mini") and Section C ("A handmade car") again and put the following words into the table below. Some words may fit in more than one column.

boring • classic • difficult • easy • fashionable • interesting • modern • organized • peaceful • requires expertise • requires patience • requires skill • requires to work quickly • traditional

The Mini	The Morgan
Jobs in the Mini factory	Jobs in the Morgan factory

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 10*, *pg. 11*, *Ex. 4*.)

8. Compare the two cars using the words from the list above.

9. Why does it take longer to make a *Morgan* than a *Mini*?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 10*, *pg. 11*, *Ex. 5*.)

10. Which car would you like to have? Why? Which factory would you like to work in? Why?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 10*, *pg. 11*, *Ex. 6*.)

Check the knowledge of active vocabulary from this part with the help of "ACTIVE VOCABULARY" section.

Part II

1. NUMERICAL CONTROL

Read texts A and B and fill in the gaps with the following words.

A.

• steps • digital • computer numerical controlled
• production • part • Numerical Control • systems
• design • component • original • produce

(*1*) ___________ (NC) refers to the automation of machine tools that are operated by abstractly programmed commands. The first NC machines were made in the 1940s and 50s. Existing tools were modified with motors. These early mechanisms were designed into (*2*) ___________ computers, and created the modern CNC—(*3*) ___________ machine tools—that have revolutionized the (*4*) ___________ process.

In modern CNC (*5*) ___________, end-to-end component design is highly automated using CAD/CAM programs. The programs (*6*) __________ a computer file that is interpreted to give the commands needed to operate a particular machine, and then loaded into the CNC machines for (*7*) ___________. Since any particular (*8*) ___________ might require the use of a number of different tools — drills, saws, etc.,—modern machines often combine multiple tools into a single "cell". In other cases, a number of different machines are used with an external controller and human or robotic operators that move the component from machine to machine. In either case the complex algorithm of (*9*) ___________ needed to produce any (*10*) ___________ is highly automated and produces a part that closely matches the (*11*) ___________ CAD design.

B.

• Computer-Aided Manufacturing • industries
• components • CAM • body design • engineers
• programs • manufacturing

(*1*) ___________ (CAM) is the use of computer-based software tools that assist (*2*) ___________ and machinists in (*3*) ___________ or prototyping product (*4*) ___________ (or parts). CAM is a programming tool that makes it possible to manufacture physical models using Computer-Aided Design (CAD) (*5*) ___________. CAM creates real life versions of components designed within a software package. CAM was first used in 1971. The first commercial use of (*6*) ___________ was in large companies in the aerospace (*7*) ___________, for example *UNISURF*, and automotive, for example *Renault* for car (*8*) ___________ and tooling.

2. THE MINI CAR

Read the text and fill in the gaps with the following words.

• market • models • 1959 • produced • fashionable
• development • original • buyers • icon • city • version
• sold • seller • generation • countries

The *Mini* is a small car that was (*1*) ___________ by the British Motor Corporation (BMC) and its successors from 1959 until 2000. That was the first (*2*) ___________ of the car. The (*3*) ___________ *Mini* is considered to be an (*4*) ___________ of the 1960s. The vehicle is in some ways considered to be the British equivalent to its German competitor, the *Volkswagen Beetle*, which enjoyed similar popularity in North America. In 1999, the *Mini* was voted the second most influential car of the 20th century, behind the *Ford Model T*.

Throughout the 1980s and 1990s the British (*5*) ___________ enjoyed numerous "special editions" of the *Mini*, which shifted the car from a mass-market item into a (*6*) ___________ icon. It was even popular in Japan. The *ERA Mini Turbo* was particularly popular with Japanese (*7*) ___________.

In 1994, BMW took control of the Rover Group, which included the *Mini*. The (*8*) ___________ of the next generation had been done between 1995 and 2001 by two competitors—Rover Group in Gaydon, United Kingdom and BMW AG in Munich, Germany. Rover wanted an economy car, whilst BMW supported a small (*9*) ___________ (or sports) car. After the last of the *Mini* production had been sold, the *Mini* name reverted to BMW ownership. Now the name of the car's brand, *MINI*, is all-capitalized, that means is all written in capital letters.

The new BMW *MINI* is technically unrelated to the old car but retains the classic transverse 4-cylinder, front-wheel-drive configuration and iconic "bulldog" stance of the original.

The 2001–2006 years included four hatchback (*10*) __________: the basic *Mini One*, the diesel-engined *Mini One/D*, the sportier *Mini Cooper* and the supercharged *Mini Cooper S*. In 2005, a convertible roof option was added. In November 2006, BMW released a re-engineered (*11*) __________ of the *Mini* which is unofficially known as the *Mk II Mini*. The *Mk II* is currently available as a hatchback and a wagon (Clubman). The convertible was still based on the *MK 1* until January 2009. Now, it is based on the *MK 2*.

At its peak, the *Mini* was a strong (*12*) __________ in most of the (*13*) __________ of the world where it was sold. A total of 1,581,887 *Minis* were (*14*) __________ in Britain only after the start of production in (*15*) __________.

3. THE MORGAN CAR

MORGAN MOTOR COMPANY

Read the text and fill in the gaps with the following words.

• made • Company • design • was
• manufacturer • production • founded
• engines • Production • 1952

The Morgan Motor (1) __________ (MMC) is a British motor car (*2*) __________. The company was (*3*) __________ in 1909 by H.F.S. Morgan and was run by him until 1959. Peter Morgan, son of

H.F.S., ran the company until a few years before his death in 2003. The company is currently run by Charles Morgan, the son of Peter Morgan.

H.F.S. Morgan's first car (*4*) ___________ was a single-seat three-wheeled vehicle which was (*5*) ___________ for his personal use in 1909. Interest in his vehicle led him to patent his design and begin (*6*) ___________. He initially showed single-cylinder and twin-cylinder versions of his vehicle at the 1911 Olympia Motor Exhibition. At this exhibition he was convinced that there would be greater demand for a two-seat model.

H.F.S. Morgan built his cars' reputation by taking part in competitions. One of his racing cars won the 1913 Cyclecar Grand Prix at Amiens in France. This became the basis for the Grand Prix model of 1913 to 1926, from which the *Aero*, *Super Sports*, and *Sports* models appeared.

These models used air-cooled or liquid-cooled variations of motorcycle (*7*) ___________. The engine was placed ahead of the axis of the front wheels in a chassis made of steel tubes.

Beginning in 1932, a new series of Morgan three-wheelers began with the *F-4*. The *F-4*, and the *F-Super* used a pressed-steel chassis and the four-cylinder Ford Sidevalve engine that was used in the *Model Y*. (*8*) ___________ of the Ford-engined three-wheelers would continue until 1952.

Morgan's first four-wheeler was the *4-4* model (with four-cylinder engine and four wheels). The first *4-wheeled Morgan* (*9*) ___________ made in 1936 and is known as the *Morgan 4-4 Series 1*. Three-wheeler production continued alongside the *4-4* model until (*10*) ___________.

• craftsmen • traditional • 10
• highly-skilled • cars • middle • unique
• introduced • handmade • list

The *Morgan +4* was (*11*) ___________ to the public in 1950 as a larger-engined (plus) car (than the *4-4*). Later the *+4+* was made in the (*12*) ___________ of the 60s with a contemporary fibreglass coupe body. The light weight and reduced drag characteristics improved the performance of the *+4+* over the regular *+4* in every aspect. However, the (*13*) ___________ *Morgan* was loved by people more. So, only 26 *+4+* cars were built.

Also a number of other models were designed. For example, *Morgan* (*14*) ___________ can be found in many areas of motorsport, including the Le Mans 24h race. Another (*15*) ___________ Morgan race car was the *Aero 8 GT* that took part in 2008 Britcar 24h races at Silverstone.

Morgan is based in Malvern Link, an area of Malvern, Worcestershire. Only 163 (*16*) ___________ employees work for the company. All the cars are still (*17*) ___________. The (*18*) ___________ do their best to prove the quality of the car. The waiting (*19*) ___________ for a car is approximately one to two years, although it has been as high as (*20*) ___________ years in the past. Only 640 cars were produced by the company in 2007.

Part III

(режим доступа для просмотра видеороликов http://englishtech.ru/video/modul_7/)

1. THE “MINI COOPER” ___________ (01:00)

Watch the video, answer the following questions, and do the following assignment.

1. *What kind of video is this?*
2. *What is the main idea of the track?*
3. *What title can you give to the video track?*
4. *Continue the title of the video above.*

2. THE MINI GREAT CARS (01:15)

Pre-listening

1. *Do you know these words?*

   Decade, icon, trend, crowd/crowded, highway, spirit, to handle.

While-listening

Watch **the whole video** and answer the following questions.

2. *What kind of video is this?*
3. *What is the main idea of the track?*

Watch **the parts of the video**, answer the following questions, and do the following assignment.

00:00—00:29

4. *What is the Mini compared to in the track?*
5. *How long did it take for the Mini to become an “icon”?*

00:40—00: 46

6. *What do the fans of the Mini think of the car?*

00:47—01:15

7. *Fill in the gaps in the following part of the text:*

There is no other (*1*) ___________ like a (*2*) ___________. It's a (*3*) ___________ car that is at (*4*) ___________ in a crowded (*5*) ___________ and equally happy out on a (*6*) ___________.

The new *Mini* was (*7*) ___________ to capture the spirit of the (*8*) ___________. It had to be (*9*) ___________, handle well and be (*10*) ___________ no matter where it's driven.

Post-listening

8. *Summarize the idea of the track in 4–6 sentences and present your summary to the class.*

3. THE MINI CAR (05:45)

Pre-listening

1. *What do you remember about the Mini from the previous videos?*
2. *Do you know these words?*
   Significant, to launch, mile, influence.

While-listening

Watch the following parts of the video, answer the following questions, and do the following assignment.

00:45—01:39

3. *What cars did the Mini leave behind?*

01:40

4. *How many cars were being produced a day in September and October 1959?*

01:50—02:28

5. *What was the original Mini-prototype's speed?*
6. *What month was the Mini introduced to people?*
7. *What year did it happen?*

02:40—03:13; 03:38—04:08

6. *The 1st interview:*
   The name of the interviewee ________________
   The job of the interviewee ________________
   What does the interviewee think of the *Mini*? ______________

03:45

7. *What can you see on the screen? Continue the following sentences:*
   This is a...
   There are...
   A Mini is...
   A new model...

04:27—04:55; 05:23—05:33

8. *The 2nd interview:*
   The name of the interviewee _______________
   The job of the interviewee _______________
   What does the interviewee think of the *Mini*? _____________

04:54—05:24

9. *What is the name of the most famous Mini prototype model?*
10. *Fill in the gaps in the following text.*

00:45—01:39

The *Mini* is the car that more than any other has changed the pace of motoring for ever. One can not (*1*) ___________ the city scope without a *Mini* being in present.

The most significantly it is impossible to look at the small car today without seeing very real evidence of the influence (*2*) ___________ has had.

In (*3*) ___________ the Ministry of Experts called the *Mini* "the most significant car of the century". This sentiment was reflected by the leadership of the old-car (*4*) ___________ in the (*5*) ___________, who also named it "the most (*6*) ___________ car of the century". The *Mini* left behind such cars as VW Beetle, Ford model "T" and (*7*) ___________.

01:50—02:28

From the area of the first (*8*) ___________ to the cars launch in (*9*) ___________ only a few major (*10*) ___________ changes were made. A reduction in (*11*) ___________ size from (*12*) ___________ cc to (*13*) ___________ cc was ordered as a direct result of the fact that early prototype's speed was (*14*) ___________ miles per (*15*) ___________, which was considered far too fast for the market.

The new capacity was arrived at power reducing the stroke from (*16*) ___________ mm in a 948 cc version to (*17*) ___________ mm in final 848 cc.

04:09—04:27

When (*18*) ___________ saw the car, it was not shy to praise it. The *Mini* is a (*19*) ___________, exceptional space efficiency and relatively good performance.

04:54—05:24

After showing some strong points of the *Mini*, (*20*) ___________ began to notice it. And the most notable was (*21*) "___________". Cooper was aware of the car's basic strengths, and such drivers as (*22*) ___________ Braden and (*23*) ___________ McCara liked it.

Post-listening

11. The whole text is:

— *instructions on how to use the car*;
— *background information about the history of the car*;
— *interviews with craftsmen.*

8. ELECTRICAL EQUIPMENT

Part I

1. Complete the statements below. Then compare your answer with the rest of the class. Which is the most popular way to learn?

When I learn to do something practical, I prefer...

(a) ...to see someone demonstrating it.
(b) ...someone to help me do it.
(c) ...to follow a diagram.
(d) ...to try and ask for help if things go wrong.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 11*, *pg. 12*, *Ex. 1.*)

2. Study the verbs in the list below and complete the sentences. There is one extra verb that you do not need to use.

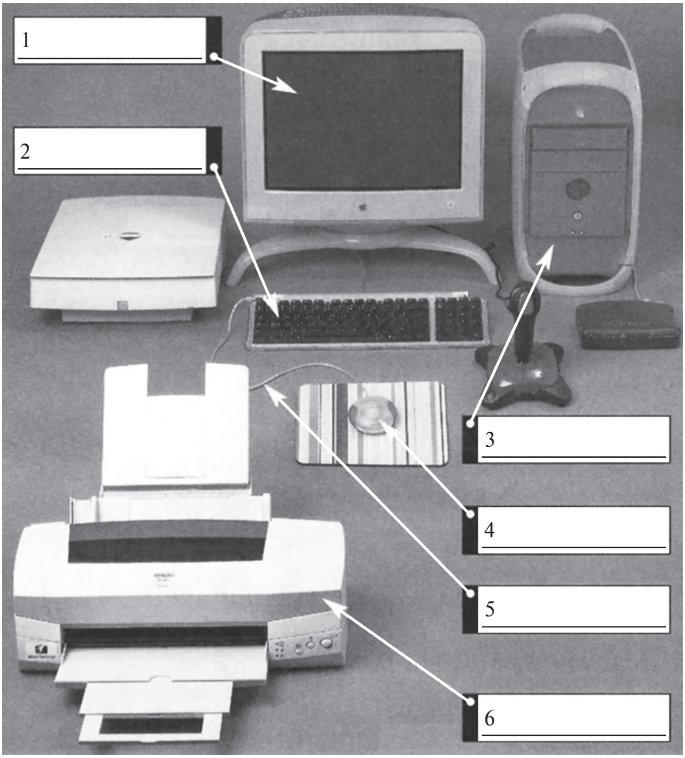
• connect • disconnect • loosen
• plug in • tighten • unplug

1. If you don't pay the bill, the electricity company will ___________ the supply.
2. ___________ the screws before you take the plug out.
3. It's sensible to ___________ your computer if there is a bad storm.
4. If you don't ___________ the TV, it won't work!
5. ___________ the video cable to the TV.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 11*, *pg. 12*, *Ex. 3.*)

3. Look at the picture and study the words in the list below. Label the computer components.

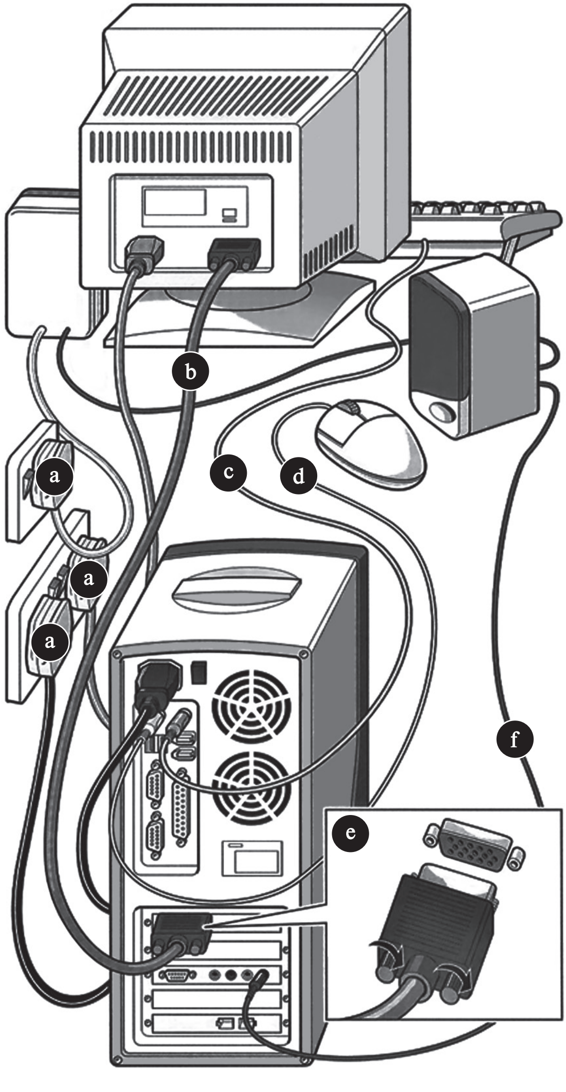
• cable • central unit • keyboard
• monitor (screen, display) • mouse • printer



("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 11*, *pg. 12*, *Ex. 2*.)

4. Read the following instructions and match them with the diagram.

1. Connect the keyboard cable to the back of the computer.
2. Connect the mouse cable to the back of the computer.
3. Plug in the monitor cable; be careful not to bend the pins.
4. Tighten the screws.
5. Connect the speakers to the back of the computer.
6. Plug the computer, monitor, and the speaker cables (in that order) into the mains supply.



(*“Engineering” Workshop by Lindsey White, OUP; Unit 11, pg. 12, Ex. 4.*)

5. Read the instructions below and match the spoken instructions (1–3) with the written instructions (a–c).

1	Put some water and turn on the gas.	a	Refer to diagram 1. Button A releases the locking mechanism.
2	If I were you, I'd put the bulb in first.	b	Remove the lid and fill from the cold tap. Place the kettle on the centre of the gas ring making sure that it is stable before turning on the gas.
3	You press that and the back opens.	c	Insert a 60 W bulb before putting the plug in the socket.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 11*, *pg. 12*, *Ex. 5*.)

6. Read the instructions in Ex. 5 again. Which instructions are about:

— a new kettle?
— a new desk lamp?
— a new camera?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 11*, *pg. 12*, *Ex. 6*.)

7. Complete the instructions for connecting a DVD recorder to a TV set. Use the words from the list.

• aerial • insert (= put in) • cable • mains
• switch • plug (*n*) • socket • TV

INSTRUCTIONS FOR CONNECTING THE DVD TO THE TV

(*1*) ___________ off your TV set.

Remove the aerial cable (*2*) ___________ from your TV set. Insert it into the ANTENNA socket at the back of the DVD recorder.

Insert one end of the aerial (*3*) ___________ into the TV socket at the back of the DVD recorder and the other end into the (*4*) ___________ *input* socket at the back of the (*5*) ___________ set.

Plug a special scart cable into the scart (*6*) ___________ at the back of the DVD recorder and the corresponding scart socket at the back of the TV set.

Switch on the TV set.

(*7*) ___________ one end of the supplied mains cable into the (*8*) ___________ socket at the back of the DVD recorder and the other end into the wall socket.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 11*, *pg. 12*, *Ex. 9.*)

8. Find the mistakes in spelling of the following words and correct them. Three words are correct.

Keybord; conect; tihten; printe; losen; unplug; caible; computer; monitor; mous.

9. Find the names of computer components in the following table (6 words). They may be written diagonally, horizontally or vertically.

	a	b	c	d	e	f	g	h	i	j
1	A	B	T	K	P	U	T	M	M	Q
2	K	E	Y	B	O	A	R	D	O	W
3	A	S	D	F	W	Z	X	G	U	E
4	X	P	C	V	B	N	M	F	S	R
5	S	W	R	T	G	S	C	D	E	T
6	M	O	N	I	S	Q	A	S	H	Y
7	L	H	M	O	N	I	T	O	R	U
8	O	P	R	I	N	T	S	J	J	I
9	Q	A	C	A	B	L	E	K	K	O
10	Z	S	P	E	A	K	E	R	L	P

10. Guess the word from its explanation.

1. A place in a wall where you put a plug into in order to connect a piece of electrical equipment to an electrical supply.
2. A small plastic object with two or three metal pins that connects a piece of electrical equipment to the main supply.
3. To make something tight.
4. To separate (or to remove) a piece of electrical equipment from electrical supply.
5. To make something less tight or less firmly fixed.
6. To remove the plug of a piece of electrical equipment from the electrical supply.

7. To join together two or more things (a video camera and a TV).
8. A set of “buttons” that people use to manage a computer
9. A screen that shows information from a computer.
10. A machine that prints information from a computer on paper.

11. Translate the following sentences into Russian. Translate the idea, not word for word.

1. Connect the printer to the computer.
2. Loosen the screw first and then disconnect the cable.
3. You must change the plug of your TV, it’s not working.
4. Unplug the phone if the battery is full.
5. Disconnect the keyboard and clean it!
6. The central unit is working but the screen isn’t showing any picture.
7. I plugged in the radio but it’s not working.
8. Please, turn on the radio—I want to listen to the news.
9. Could you switch the light off—I’m trying to relax.
10. Something is wrong with the cable; I think you should change it to a new one.

Check the knowledge of active vocabulary from this part with the help of “ACTIVE VOCABULARY” section.

Part II

1. PLUGS AND SOCKETS

1. Read texts A and B and fill in the gaps with the following words.

A.

• sockets • risk • connecting • connect • systems
• electric • designed • connector • cable • socket • types
• connection • electricity • electrical

Power plugs and (*1*) ___________ are devices for (*2*) ___________ electrically-operated devices to the power supply.

An (*3*) ___________ plug is an electrical (*4*) ___________ with a contact pin that is connected to a (*5*) ___________. Wall sockets are also known as power points, power sockets, or electrical outlets. They are electrical connectors that have holes which accept and deliver (*6*) ___________ to the pins of inserted plugs. Sockets are (*7*) ___________ to accept only matching plugs and reject all others. To reduce the (*8*) ___________ of injury or death by electric shock, some plug and socket (*9*) ___________ incorporate various safety features and design aspects.

An electrical (*10*) ___________ between discrete points allows the flow of electrons (electric current). A pair of connections is needed for a circuit. The connection may be of two (*11*) ___________—temporary (as for portable equipment that can be removed) and permanent (as for electrical joint between two wires or devices).

An (*12*) ___________ connector is a conductive device for joining electrical circuits together. There are hundreds of types of electrical connectors. Connectors may join two lengths of flexible wire or cable, or may (*13*) ___________ a wire or (*14*) ___________ to an electrical terminal.

B.

• two • electrical • pins • socket
• connection • equipment • connector
• industrial • tight • known • plug

(*1*) ___________ and socket connectors are usually made up of a male plug and a female socket. Although, *hermaphroditic* connectors also exist. Plugs generally have one or more (*2*) ___________ that are inserted into holes in a (*3*) ___________. The (*4*) ___________ between the metal parts must be sufficiently (*5*) ___________ to make a good electrical connection and complete the circuit. When working with multi-pin connectors, it is helpful to have a pin-out diagram to identify the wire or circuit node connected to each pin.

A power (*6*) ___________ is an electrical connector designed to carry a significant amount of (*7*) ___________ power, usually as DC or low-frequency AC. There are (*8*) ___________ main AC power types: mains power plugs (principally used for connecting (*9*) ___________ to wall outlets) and industrial power plugs (used for (*10*) ___________ equipment on plants or manufactures) that are normally larger than mains plugs. Connectors carrying small amounts of power are (*11*) ___________ as *signal connectors*.

2. Study the following information, try to understand it and remember it.

There are substantial differences between American and British terminology related to power plugs and sockets.

British English	American English	Meaning
mains power	line power	The primary electrical power supply wires entering a building, connected to the main supply.
domestic power	—	Single-phase 230 V power as used in a single-family residence.
earth connection	ground (or grounding) connection	Safety connection to the earth or ground.
live connection	hot (or live) connection	Phase (“active”) connection.
neutral connection	neutral (or cold) connection	Return connection.
flex (or mains) lead, mains wire (or wiring)	line (or power) cord	Flexible electric cable from plug to appliance.
pin (or plug)	prong (or plug)	Male part of an electrical connector.

2. COMPUTER COMPONENTS

(1)

1. Read the following text and fill in the gaps with the following words.

• automobiles • 1960s • personal • computer
• individuals • operating • instructions
• microprocessors • made • modern • part
• Central Processing Unit • development

A (*1*) ___________ is a machine that manipulates data according to a set of (*2*) ___________.

A (*3*) ___________ computer (PC) is any general-purpose computer whose size, capabilities, and original sales price make it useful for (*4*) ___________.

A personal computer is (*5*) ___________ of multiple physical components of computer hardware, upon which can be installed an (*6*) ___________ system and a multitude of software to perform the operator's desired functions.

The main (*7*) ___________ of a computer is the (*8*) ___________ (CPU), or the processor. It is the part of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the computer's functions. This term has been in use in the computer industry at least since the early (*9*) ___________. The form, design, and implementation of CPUs have changed dramatically since the earliest examples, but their fundamental operation remains much the same.

Early CPUs were custom-designed as a part of a larger, sometimes one-of-a-kind, computer. However, this costly method of designing custom CPUs for a particular application has given way to the (*10*) ___________ of mass-produced processors that are made for one or many purposes. This standardization trend generally began in the era of discrete transistor mainframes and minicomputers and has rapidly accelerated with the popularization of the integrated circuit (IC). The IC has allowed increasingly complex CPUs to be designed and manufactured to tolerances on the order of nanometers. Both the miniaturization and standardization of CPUs have increased the presence of these digital devices in (*11*) ___________ life far beyond the limited application of dedicated computing machines. Modern (*12*) ___________ appear in everything from (*13*) ___________ to cell phones and children's toys.

2. Aswer the questions about the text.

1. What does a "personal computer" mean?
2. Which part of a computer is the most important? Give two terms for it.
3. When did people begin using these terms?
4. What is the main difference between the oldest model of CPU and the modern one?
5. What are the modern uses of microprocessors?

(2)

3. Read the text below and match the headings to its parts (A—G).

• A microphone • A speaker system
• A printer • A keyboard • A monitor
• A webcam • A mouse

4. Read the same text and fill in the gaps with the following words.

• include • printer • devices
• mouse • output • monitor

A computer has two types of (*1*) ___________ —the "input" devices and the (*2*) "___________" devices. Input devices (*3*) ___________ a keyboard, a (*4*) ___________, a microphone, a webcam. Output devices include a (*5*) ___________, a speaker system, a (*6*) ___________ system.

A. _________________________

• actions • numbers • input
• characters • symbol • keys

In computing, this piece of equipment is an (*1*) "___________" device, partially modeled after the typewriter keyboard, which uses an arrangement of (*2*) ___________ (or buttons) to act as mechanical levers or electronic switches. A keyboard typically has characters (letters, (*3*) ___________ or signs) printed on the keys and each press of a key typically corresponds to a single written (*4*) ___________. However, to produce some symbols requires pressing and holding several keys simultaneously or in sequence. While most keyboard keys produce letters, numbers or signs—(*5*) "___________" as they are called, other keys or simultaneous key presses can produce (*6*) ___________ or computer commands.

• used • commands • program
• system • keyboard • shuts down

In normal usage, the (*7*) ___________ is used to type texts and numbers into a word processor, text editor, or other (*8*) ___________. In a modern computer, the interpretation of keypresses is generally left to the software. A computer keyboard distinguishes each physical key from every other and reports all keypresses to the controlling software. Keyboards are also (*9*) ___________ for computer gaming, either with regular keyboards or by using keyboards with special gaming features, which can expedite frequently used keystroke combinations. A keyboard is also used to give (10) ___________ to the operating (11) ___________ of a computer, such as Windows' Control-Alt-Delete combination, which brings up a task window or (12) ___________ the machine.

B. _________________________

• consists • device • display
• two-dimensional • buttons

In computing, this piece of equipment is a *pointing* (*1*) ___________ that functions by detecting (*2*) ___________ (2D) motion relative to its supporting surface. Physically, a mouse (*3*) ___________ of an object held under one of the user's hands, with one or more (*4*) ___________. It sometimes features other elements, such as "wheels", which allow the user to perform various system-dependent operations. The mouse's motion is typically translated into the motion of a cursor on a (*5*) ___________, which allows fine control of a Graphical User Interface.

• 1981 • models • mouse
• integrated • computers

The name *mouse*, originated at the Stanford Research Institute, derives from the resemblance of early (*6*) ___________ (which had a cord attached to the rear part of the device, suggesting the idea of a tail) to the common mouse.

The first marketed (*7*) ___________ mouse—shipped as a part of a computer and intended for personal computer navigation—came with the Xerox 8010 Star Information System in (*8*) ___________. A mouse now comes with most (*9*) ___________ and many other varieties can be bought separately. Laptops come with integrated (*10*) __________.

C. ________________________

• television • sound • voice • systems
• electromagnetic • signal • microphone

This is (colloquially called a "mic" or "mike") an acoustic-to-electric sensor that converts (*1*) ___________ into an electrical (*2*) ___________. In 1876, Emile Berliner invented the first (*3*) ___________ used as a telephone voice transmitter. Microphones are used in many applications such as telephones, tape recorders, karaoke (*4*) ___________, hearing aids, motion picture production, live and recorded audio engineering, FRS radios, megaphones, in radio and (*5*) ___________ broadcasting, and in computers for recording (*6*) ___________, speech recognition, VoIP, and for non-acoustic purposes such as ultrasonic checking or knock sensors.

Most microphones today use (*7*) ___________ induction (dynamic microphone), capacitance change (condenser microphone, pictured right), piezoelectric generation, or light modulation to produce the signal from mechanical vibration.

D. ________________________

• original • network • expensive • programs (×2)
• videophone • include • video

This is a (*1*) ___________ device connected to a computer or *computer* (*2*) ___________, often using a USB port or, if connected to a network, Ethernet or Wi-Fi. The most popular use is for video telephony, permitting a computer to act as a (*3*) ___________ or video conferencing station. This can be used in messenger (*4*) ___________ such as Windows Live Messenger, Skype and Yahoo messenger services. Other popular uses, which (*5*) __________ the recording of video files or even still images, are accessible via numerous software (*6*) __________, applications, and devices. Webcams are known for low manufacturing costs and flexibility, making them the lowest cost form of videotelephony. The term "webcam" may also be used in its (*7*) __________ sense of a video camera connected to Web continuously for an indefinite time, rather than for a particular session, generally supplying a view for anyone who visits its Web page. Some of these, for example those used as online traffic cameras, are (*8*) __________ professional video cameras.

E. ______________________

• types • display • monitors • equipment
• disadvantages • images

A monitor or (*1*) __________ (sometimes called a visual display unit) is a piece of electrical (*2*) __________ which displays (*3*) __________ generated by devices such as computers, without producing a permanent record. There are different (*4*) __________ of monitors—CRT, LCD, Plasma, Penetron. Each type has its own pros and cons (or advantages and (*5*) __________). The display device in modern (*6*) __________ is typically a thin film transistor liquid crystal display (TFT-LCD), while older monitors use a Cathode Ray Tube (or CRT).

F. ______________________

• plastic • produce • headphones
• devices • integrated • price
• produces • improve • connect

Computer speakers, or multimedia speakers, are external (*1*) __________ of a computer. Computer speakers range widely in quality and in (*2*) __________. The computer speakers typically packaged with computer systems are small (*3*) __________ boxes with mediocre sound quality. Some of the slightly better computer speakers have equalization features such as bass and treble controls, which (*4*) __________ the sound quality. More sophisticated computer speakers may have a “subwoofer” unit. Laptops come with (*5*) ___________ speakers. Unfortunately the tight restriction on space in laptops means these speakers (*6*) ___________ low-quality sound. Some users (*7*) ___________ computer sound output to an existing stereo system. This normally (*8*) ___________ much better results than small low-cost computer speakers. Computer speakers can also serve as an economy amplifier for MP3 player use for those who wish not to use (*9*) ___________ although some models of computer speakers have headphone jacks of their own.

• cable • speakers • products
• port • sound • components

Simple computer (*10*) ___________ often have a low-power internal amplifier. The standard audio connection is a 3.5 mm ($^1/_8$ inch) stereo jack plug often colour-coded lime green (following the PC 99 standard) for computer (*11*) ___________ cards. A plug and socket are for a two-wire (signal and ground) (*12*) ___________ that is widely used to connect analog audio and video (*13*) ___________. Also called a “phono connector”, rows of RCA sockets are found on the backs of stereo amplifier and numerous A/V (*14*) ___________. The prong is $^1/_8$" thick by $^5/_{16}$" long. A few use an RCA connector for input. There are also USB speakers which are powered from the 5 volts at 200 milliamps provided by the USB (*15*) ___________, allowing about half a watt of output power.

G. ___________________________

• slower • digital • copy • designed
• devices • printer • cost
• scanner • cable • copying

In computing, this piece of equipment is a device which produces a (*1*) ___________ (permanent readable text and/or graphics) of documents stored in electronic form, usually on physical print media such as paper or transparencies. The world’s first computer (*2*) ___________ was a 19th century mechanically driven apparatus invented by Charles Babbage for his Difference Engine.
Many printers are primarily used as local peripherals and are attached by a printer (*3*) ___________ or, in modern printers, a USB cable to a computer which serves as a document source.

Some printers, commonly known as network printers, have built-in network interfaces (typically wireless and/or Ethernet), and can serve as a hardcopy device for any user on the network.
Individual printers are often (*4*) ___________ to support both local and network connected users at the same time. In addition, a few modern printers can directly interface to electronic media such as memory sticks or memory cards, or to image capture devices such as (*5*) ___________ cameras, scanners. Some printers are combined with a (*6*) ___________ and/or fax machine in a single unit, and can function as photocopiers. Printers that include non-printing features are sometimes called Multifunction printers (MFP), Multi-Function Devices (MFD), or All-In-One (AIO) printers. Most MFPs include printing, scanning, and (*7*) ___________ among their features.
However, printers are generally slow (*8*) ___________ (30 pages per minute is considered fast). And many inexpensive consumer printers are far (*9*) ___________ than that. And the (*10*) ___________ per page is actually relatively high.

5. Answer the following questions about the text above.

A.

1. What are input and output devices of a computer?
2. What does "a character" mean when we speak about keyboards?
3. Why are keys pressed simultaneously sometimes?
4. What is the purpose of a keyboard?
5. What is responsible for "understanding" the keypresses?
6. Can a keyboard be used for entertaining?

B.

7. What is responsible for work of a computer mouse?
8. What are the operating parts of a computer mouse?
9. Why was it called "a mouse"?
10. What does an "integrated" mouse mean?
11. When did an integrated mouse appear?

C.

12. What is the main function of a microphone?
13. When did the first microphone appear?
14. What is the list of main ways of a microphone usage?

D.

15. What is the main function of a webcam?
16. What is the most popular use of a webcam?
17. What is needed for recording videos with the help of a webcam?

E.

18. What is a “monitor”?
19. What are different types of monitors?
20. What is the difference between modern and old-fashioned monitors?

F.

21. What is a “computer speaker”?
22. What kind of computer speakers does a laptop have?
23. Why do laptop speakers produce a low-quality sound?
24. What can you do to improve the sound of a computer?

G.

25. What is the main function of a printer?
26. How are printers connected to computers?
27. What can a printer be combined with?
28. What is an ordinary speed of a common printer?

3. COMPUTER ENGINEERING

Read the text and fill in the gaps with the following words.

• computer • focuses • engineers • discipline
• design • personal • engineering

Computer engineering (also called electronic and computer engineering, or computer systems engineering) is a (*1*) ___________ that combines both electronic (*2*) ___________ and (*3*) ___________ science. The abbreviation is EECS. Computer engineers usually have training in electronic engineering, software design and hardware-software integration instead of only software engineering or electronic engineering. Computer (*4*) ___________ are involved in many aspects of computing, from the (*5*) ___________ of individual microprocessors, (*6*) ___________ computers, and supercomputers, to circuit design.

This field of engineering (*7*) ___________ not only on how computer systems work themselves, but also how they integrate into the larger picture.

• designing • monitor • include
• digital • engineers

Usual tasks involving computer engineers (*8*) ___________ writing software and firmware for embedded microcontrollers, designing VLSI chips, (*9*) ___________ analog sensors, designing mixed signal circuit boards, and designing operating systems. Computer (*10*) ___________ are also suited for robotics research, which relies heavily on using (*11*) ___________ systems to control or (*12*) ___________ electrical systems like motors, communications, and sensors.

• covers • electricity • 19th
• electromagnetism • power

Electrical engineering (sometimes referred to as electrical and electronic engineering) is a field of engineering that deals with the study and application of (*13*) ___________, electronics and (*14*) ___________. The field first became an identifiable occupation in the late (*15*) ___________ century after commercialization of the electric telegraph and electrical (*16*) ___________ supply. It now (*17*) ___________ a range of subtopics including power, electronics, control systems, signal processing and telecommunications.

• electricity • small • information
• engineering • computers

Electrical (*18*) ___________ may or may not include electronic engineering. A distinction is made usually outside of the United States. Electrical engineering is considered to deal with the problems associated with large-scale electrical systems such as power transmission and motor control, whereas electronic engineering deals with the study of (*19*) ___________-scale electronic systems including (*20*) ___________ and integrated circuits. Alternatively, electrical engineers are usually concerned with using (*21*) ___________ to transmit energy, while electronic engineers are concerned with using electricity to transmit (*22*) ___________.

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_8/)

1. HOW TO CONNECT ELECTRICAL EQUIPMENT (01:50)

Pre-listening

1. *Read the words and their explanations; try to understand their meaning.*

   Jack = electronic connection between two pieces of electrical equipment;

   semi = half, ex. semi-circle, semi-automat;

   wire = a piece of metal in the form of a thin thread that is used to carry electricity;

   cord (US) = a kind of a cable to carry wires;

   channel = ex. a TV station, a radio station, etc.;

   to play back = to turn on the TV or recorder and watch or listen to something again.

While-listening

Listen to the track **without video**, answer the following questions, and do the following assignment.

2. *What is being connected?*
3. *What is the model of a camera?*
4. *Why are colours mentioned?*
5. *What is the order of the colours mentioned?*
6. *Listen, watch the video, and fill in the gaps in the following text.*

00:00—00:45

So, now we talk about (*1*) ____________ your XHA1 to a (*2*) ____________ or a (*3*) ____________. And the way you do that is, first of all, ..., using your (*4*) ____________ RCA (*5*) ____________ to a mini (*6*) ___________, and ... this should come with your XHA1. And if you've used this before, all the TVs ... have the simple "IN"—(*7*) ___________ for (*8*) ___________, (*9*) ___________ and (*10*) ___________ for audio (*11*) ___________. This is a standard definition.

00:46—00:59

You can use a componic cable that came with your XHA1. Its cord—(*12*) ___________, ___________, ___________ video (*13*) ___________ and this is pretty much able to (*14*) ___________ on your newer high-definition white (*15*) ___________ TVs.

01:00—01:50

And for connecting to a (*16*) ___________ you'll need a Firewire (*17*) ___________, like this one. The semi (*18*) ___________ to a camera and the semi connects to the back of a computer.

So, where do all these connections take place is right here, next to the (*19*) ___________ door. And we've got a couple of connections. You see a Firewire—as this HDV/DV. And that's what you do to connect your (*20*) ___________.

And you've got this yellow (*21*) ___________ right here. And that's the way you use your standard (*22*) ___________ cables.

And below that is where the "componic" (*23*) ___________ connects, so you can playback in HD on an HD-television.

So, those are the (*24*) ___________ you can connect your cam coder to a (*25*) ___________ or a computer and help playback your tape on a television or a computer.

Post-listening

Do the following assignments.

7. *Summarize the instructions on how to connect a camera to a TV or a computer.*
8. *Watch the video without audio and make comments.*
9. *Write the instructions on how to connect a photo camera to a computer, a microphone to a computer, a mobile phone to a computer, a DVD player to a TV, etc.*

2. COMPUTER COMPONENTS (02:18)

Pre-listening

1. *Do you know the following words?*

   Visible, generation, integrate(d).

2. *What computer components do you remember?*

While-listening

Listen **to the parts** of the track **without video** and answer the following questions.

00:00—01:40

3. *What is the order of computer components mentioned in the track?*
4. *Which is said to be the most visible part; the most important part?*
5. *How many speakers may there be?*

01:40—end

6. *What is described in this part of the track?*
7. *What is laptop ideal for?*
8. *Who is laptop ideal for?*

Listen to **the whole track** and **watch** the video.

9. *What do the words "power button", "laptop" mean? Where can you find a power button, a floppy disk, a DVD-ROM on a computer (on a laptop)?*
10. *What kind of mouse does a laptop have?*
11. *What are the differences between a computer and a laptop?*
12. *Listen, watch, and write down the text.*

Post-listening

13. *Compare your text with the original below and find out what was misheard.*

So, let's see: which are the main components of a computer.

Lovely.

OK. The most visible part, the most visible component is "the screen".

Next one is "the keyboard" with lots and lots of keys.

We have two audio "speakers". Now, this can have more than two speakers—five speakers, around speakers or something like that.

This is "the mouse", one that I'm using right now.

And the most important component—"the central unit" which contains memory, contains the CP-wheel which gives the computer its power, a floppy disk, CD-Rom, DVD-Rom and the power button.

Here we have the next generation of screens or displays, OK, this is a light one—you can see a lot of space. It is said it is good, it is better for eye.

So, here we have a laptop. This is a smaller computer with smaller keyboard and integrated mouse and smaller screen. OK, here must be the floppy and DVD-Rom and other components. This is ideal for travelling and for business people.

*14. Watch the video **without audio** and make comments on it.*

9. SAFETY EQUIPMENT

Part I

Section A

1. **Read the sentences below. How do you say these things in your language? Where can you find these notices? What do we call this kind of sentences?**
   (a) Wash your hands.
   (b) Beware of the dog.
   (c) Don't throw litter!
   (d) Don't lean out of the windows!

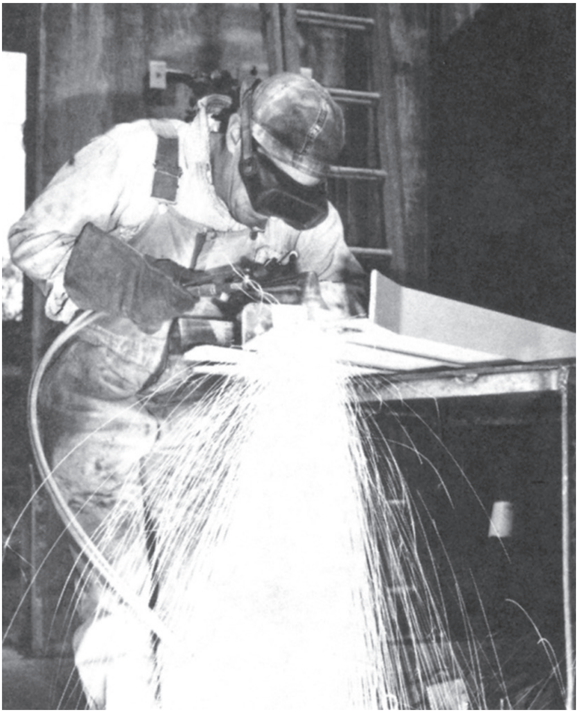
("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 12*, *pg. 14*, *Ex. 1*.)

2. **(a) Look at the picture. What does this man do?**

   (b) What safety equipment is he wearing? Study the following words and try to match a word and a piece of safety equipment.

• hard hat • goggles • gloves
• ear defenders • mask
• boiler suit • safety boots

   (c) Which words of the list are left?



("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 12*, *pg. 14*, *Ex. 2*.)

3. Study the following signs (a–k). Match the meanings (1–4) with the shapes (A–D) and colours (E–H).

Meaning		Shape		Colour	
1	You must not do this.	A	triangle	E	yellow and black
2	You must do this.	B	circle with diagonal line	F	red and white
3	There is a danger.	C	square	G	blue and white
4	This material is dangerous.	D	circle	H	orange and black

To find out the colour of each sign
have a look at the same picture at http://englishtech.ru.

WARNING AND INSTRUCTION SIGNS

a

b

c

d

e

f

g

h

i

j

k

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 12*, *pg. 14*, *Ex. 3.*)

4. Read the instructions and warnings below. First, study any new words in the glossary or your dictionary. Then match the sentences with the signs (a–k) from Ex. 3.

1	Be careful.
2	Beware of industrial vehicles.
3	Don't smoke here.
4	Don't walk here.
5	Risk of death.
6	This material is corrosive.
7	This material is explosive.
8	This material is flammable.
9	Wear a hard hat.
10	Wear ear defenders.
11	Wear goggles to protect your eyes.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 12*, *pg. 14*, *Ex. 5*.)

5. Choose the right words to complete the sentences below.

1. Petrol and oil are flammable/vehicles.
2. Acid is flammable/corrosive.
3. TNT and dynamite are corrosive/explosive.
4. Wear a hard hat/goggles when you work with chemicals.
5. You must wear a hard hat/goggles on a building site.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 12*, *pg. 14*, *Ex. 6*.)

6. Match the words with their definitions.

• goggles • safety equipment • boots
• mask • hat • sign • boiler suit
• gloves • ear defenders • hard hat

1	A covering that you wear on your head, usually when you are outdoors.	
2	Special glasses that you wear to protect your eyes at work.	
3	A kind of covering for your hands usually made of leather, wool, rubber.	
4	A kind of covering for your feet usually made of leather, rubber.	

5	One-piece clothing that you wear over your normal clothes when you do rough and dirty work.	
6	A thing that you put on your ears to protect them from noise.	
7	A kind of a picture that helps us understand what we must (should) or must not (should not) do.	
8	A kind of a protective hat that engineers usually wear on a building site.	
9	Things that people put on to protect their bodies from danger.	
10	Something that you wear that covers your face or part of your face to protect it.	

7. Make up sentences using the given word and the verb *to protect* as it is shown in the example (0).

0	*hat*	*Hat protects our head.*
1	goggles	Goggles protect ...
2	gloves	Gloves ...
3	boots	
4	boiler suit	
5	ear defenders	
6	mask	
7	safety equipment	

8. Complete the sentences using *must put on…* and different pieces of safety equipment as it is shown in the example (0).

0	*A welder*	*must put on gloves, hard hat, goggles, boiler suit, boots, ...*
1	An outdoor engineer	
2	A miner	
3	A builder	
4	A car mechanic	
5	A gardener	
6	A chemical worker	
7	A medical worker	
8	A mountain climber	

9. Give instructions using the Imperative (*Go…, Take…, Write…, Improve…*) according to the suggested situation as it is shown in the example (0). Try to use the known vocabulary. More than one answer is possible.

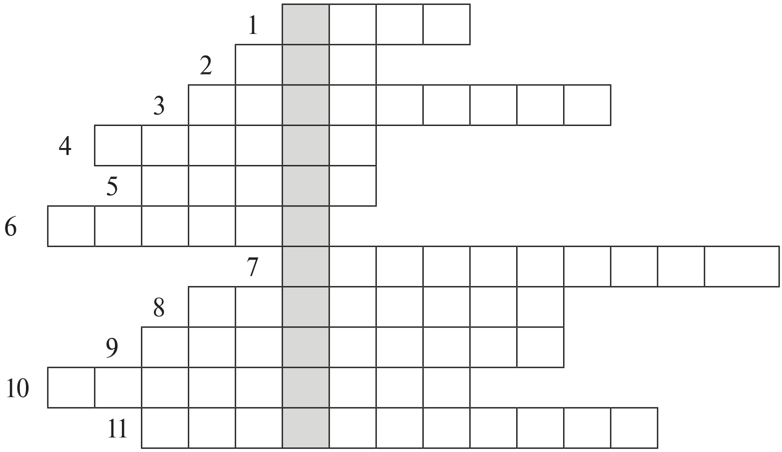
0	*I work with corrosive acids. Put on gloves. (Be careful; Use gloves, etc.)*
1	I want to make a drawing by hand.
2	The doctor needs to put an implant into the patient's body.
3	I need to solve this problem quickly and productively.
4	I want to go to England.
5	I want to work with the best apprentice.
6	I want to get a certificate in this sphere.
7	I need a light, easy to shape, but strong material.
8	I want to join blocks.
9	I need to report about modern inventions.
10	I can't see anything because of the sun.
11	I want to create an accurate and consistent drawing.
12	I'm sure this project is the best.
13	This car model has become an old-fashioned.
14	The computer is not working.

If it was difficult to you, match the following expressions with the situations.

• Speak about alloys or implants • Improve your knowledge
• Do it in a methodical way • Put on sunglasses
• Use technical drawing equipment
• Show its advantages • Interview all the candidates
• Check the cable • Take plastic or aluminium
• Compress it first • Design a new model
• Improve your English • Use a computer
• Mix water and cement

Try to think about similar answers of your own.

10. Do a crossword. What is hidden on the vertical highlighted line?



1. You can see these things (or objects) while driving along the road. All the drivers must know what these things (or objects) mean.
2. A piece of clothing that you put on your head to protect it from wind, cold, etc.
3. “Beware of noise! Put on your ear __________,” said the instructor to the group of young apprentices.
4. These things can be made of leather, wool, rubber. Everybody use them, especially in winter.
5. If you want to _________ yourself, don’t forget to put on a hard hat and gloves.
6. __________ equipment is very important if you are a welder.
7. Don’t put the iron near the window—the curtains are _____________.
8. Δ What shape is this?
9. Some chemicals are very ___________, so put on safety gloves on your hands.
10. Be careful with gas—it is very _____________.
11. Detailed information on how to do something.

Section B

SIGNS

1. Have a quick look at the signs below. Do they "warn" or "forbid"?

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

2. Match the following key-word expressions with the signs (1–15) from Ex. 1.

• pour water • smoke • use lift
• eat • use broken tools • walk
• use mobiles • people with heart problems
• wear metal things • drink water • touch
• take animals • people with implants
• use electrical equipment • touch (press)

1	6	11
2	7	12
3	8	13
4	9	14
5	10	15

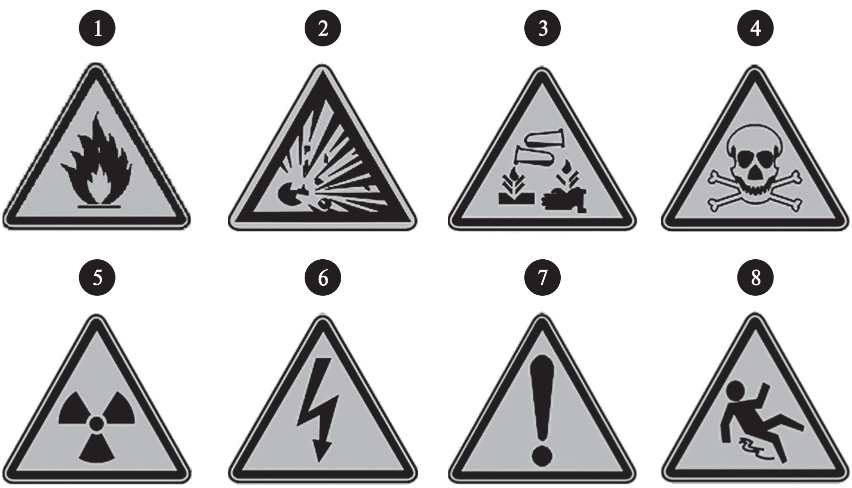
3. What do the signs (1–15) from Ex. 1 mean? Make up a comment to each sign using the negative form of the Imperative as it is shown in the example (1).

1	Don't smoke here!
2	
3	
4	
5	
6	
7	
8	
9	
10	Don't let ...
11	Don't let ...
12	
13	
14	
15	

4. Now rewrite the same sentences as it is shown below. There are some examples for you.

1	No smoking!
2	
3	
4	
5	No animals!
6	
7	
8	
9	
10	No people with heart problems!
11	
12	
13	
14	
15	

5. Now have a quick look at the signs below. Do they "warn" or "forbid"?



9

10

11

12

13

14

15

16

6. Match the following key-word expressions with the signs (1–16) from Ex. 5.

• cold/coldness • toxic materials
• slippery surface • flammable materials
• radioactivity • automatic switching on
• explosive materials • danger
• corrosive materials • a train
• biological danger • welding
• high voltage • a car
• hot surface • falling objects

1	9
2	10
3	11
4	12
5	13
6	14
7	15
8	16

7. What do the signs from Ex. 5 mean? Make up a comment on each sign using the example.

1	Beware of flammable materials!
2	Beware of...
3	Beware...
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. SAFETY ENGINEERING

Read the text and fill in the gaps with the following words.

• problems • science • safe • expensive
• design • discovers • system

Safety engineering is an applied (*1*) ___________ strongly related to engineering systems and the System Safety Engineering.

Safety engineers take an early (*2*) ___________ of a system, analyse it to find what faults can occur, and then propose safety requirements in design specifications and changes to existing systems to make the (*3*) ___________ safer. In other words, safety engineers need to prove that an existing, completed design is (*4*) ___________. Their main function is to prevent any safety (*5*) ___________ beforehand, at the stage of design. If a safety engineer (*6*) ___________ significant safety problems after the design process is completed, it can be very (*7*) ___________ to correct them.

• spacecraft • unite • software • known
• complex • organizations • control

Some large government agencies (*8*) ___________ and form a system. This is (*9*) ___________ as System Safety. The System Safety philosophy, supported by the System Safety Society and many other (*10*) ___________, is to be applied to complex systems, such as commercial airliners, military aircraft, complex weapon systems, space and (*11*) ______________ systems, rail and transportation systems, air traffic control system and more (*12*) ___________ and safety-critical industrial systems. Nowadays (*13*) ___________ safety is a fast-growing field since modern systems functionality is under (*14*) ___________ of software.

2. SAFETY EQUIPMENT INSTITUTE (SEI)

Read the text and fill in the gaps with the following words.

• protective • Manufacturers • standards (×2) • organization
• level • manufacturer • test • equipment • services

The Safety Equipment Institute (SEI) is a private, non-profit (*1*) ___________ established to manage non-governmental programs to (*2*) ___________ and certify a broad range of safety and (*3*) ___________ products. It works with assorted standards organizations to verify that various products meet the safety (*4*) ___________ which are set for them. SEI certification programs are voluntary and available to any (*5*) ___________ of safety and protective (*6*) ___________ who wants to have products certified by SEI.

(*7*) ___________ and consumers are assured that products having the SEI label have been manufactured to meet the (*8*) ___________ of quality and performance of the most current comprehensive (*9*) _____________ that exist for the product.

SEI has an alliance with INSPEC International, Ltd., a notified body located in the UK. Together, they offer a variety of testing (*10*) _____________, CE Marking, and ISO Registration.

3. SAFETY EQUIPMENT

(1)

1. Read the text and fill in the gaps with the following words.

• important • protect • protective
• environment • injury

"Personal (*1*) ___________ equipment" (PPE) means practically the same as the term "safety equipment" (SE). It refers to protective clothing, helmets, goggles, or other garment (= piece of clothing) designed to (*2*) ___________ the person's body from (*3*) ___________ by electrical hazards, heat, chemicals, infection, etc.

PPE can also be used to protect the working (*4*) ___________ from pesticide application, pollution or infection from the worker (for example in a microchip factory). The protection may be also (*5*) ___________ in other spheres, such as medicine, for example.

(2)

2. Read the text and match the headings with its parts (A—E).

• Goggles • A helmet • Safety boots
• Ear defenders • A boiler suit

Read the same text and fill in the gaps with the following words.

A. ___________________________

• plastic • protect • injuries
• used • metal • made

It is a form of protective gear that people wear on the head to protect it from (*1*) ___________. It's a variation of a hat. The oldest known use of helmets was by Assyrian soldiers in 900 BC, who wore thick leather or bronze helmets to (*2*) ___________ the head from sword blows and arrows. In the 2000s, soldiers still wear helmets, now often made from Kevlar rather than (*3*) ___________, to protect the head from bullets.

In civilian life, helmets are (*4*) ___________ for recreational activities and sports (e.g. jockeys in horse racing, American football, ice hockey, cricket, and rock climbing); dangerous work activities (e.g. construction, mining); and transportation (e.g. motorcycle helmets and bicycle helmets).

Helmets were originally (*5*) _____________ of metal, then fiberglass. Since the 1990s, most helmets are made of resin or (*6*) ___________.

• engineers • transparent • yellow
• eyes • objects • hard hat • sites

Hard hats may also be fitted with a visor (as in a welding helmet). It is made of (*7*) ___________ material and let a person look through it without problems and protect his or her (*8*) ___________ at one and the same time.

A (*9*) ___________ is a type of helmet usually used in workplace environments, such as building (*10*) ___________, to protect the head from injury by falling (*11*) ___________, bad weather, and electric shock. A hard hat issued by a firm may have that firm's name or some word or logo on its front.

The colour of a hard hat can signify different roles on building sites. For instance, white might signify supervisors or (*12*) ___________, blue—technical advisors, red—safety inspectors, and (*13*) ___________— labourers.

In 1997, the American National Standards Institute revised its standards for hard hats.

B. ___________________________

• jeans • clothing • boiler suits
• newspaper • tools • protective

This is a type of garment which is usually used as protective (*1*) ___________ when working. Some people call it a "pair of overalls" by analogy with "pair of trousers" (or an "overall" in American English).

The term "overall" has been known since 1792. The term "boiler suit" appeared first on the 28th of October 1928 in the *Sunday Express* (*2*) ____________. In the beginning of the 20th century, overalls came in as (*3*) ___________ garments for mechanics in the USA. Women wore overalls in factories in England during the First World War in 1916. Suitable overalls were required for all workers employed in the factory. During the Spanish Civil War, the Communist soldiers used (*4*) ___________ as their uniform. Early aeronauts also wore specially designed one-piece suits. In the 1930s, overalls were used as comfortable children's clothes. After WWII, many athletes also admitted the advantages of overalls. Overalls have sometimes been items of fashion, in the 1960s and 1970s—especially made of (*5*) ___________.

A boiler suit (or an overall) is usually made of denim or any other strong material and often has large pockets for different (*6*) ___________. It is a one-piece garment. It may be fastened with buttons or a zipper. Today overalls has become clearly work clothes.

C. __________________________

• material • water • laboratories
• from • tools • eyes • used • types
• protect • adapt • ground

This item is a form of protective eyewear that usually protects the eye area in order to prevent particulates, infectious fluids, or chemicals from striking the eyes. They are used in chemistry (*1*) ___________ and in woodworking. They are often (*2*) ___________ in snow sports as well, and in swimming. For example, when swimming, goggles protect the eyes against (*3*) ___________. Goggles are often worn when using power (*4*) ___________ such as drills or chainsaws to prevent flying particles from damaging the eyes.

There are different (*5*) ___________ of goggles. The requirements for goggles depend on their type and the way they are used. For example:

— goggles for cold weather must have two layers of lens to prevent the interior (*6*) ___________ becoming “foggy”;
— goggles for swimming must be watertight to prevent water (such as salt water when swimming in the ocean, or chlorinated water when swimming in a pool) from irritating the (*7*) ___________. They must allow swimmers to see clearly underwater;
— goggles for tools must be made of an unbreakable (*8*) ___________ that prevents chunks of metal, wood, plastic from hitting the eye;
— goggles for welding must be made of an unbreakable material to protect the eyes from glare and flying sparks and hot metal splashes while using;
— goggles for motorcycle riding and other open-air activities must prevent insects, dust, and so on from hitting the eyes;
— goggles for laboratory and research must combine impact resistance with side shields to prevent chemical splashes reach the eyes. May also include laser protection;
— goggles for winter sports must (*9*) ___________ the eyes from glare and from icy particles flying up from the (*10*) ___________;
— goggles for astronomy and meteorology must be dark to be used before going outside at night, in order to help the eyes (*11*) ___________ to the dark.

D. ___________________________

• plastic • construction • foot • indicates
• certification • symbols • injury

This is a kind of shoes that have a protective reinforcement to protect the (*1*) ___________ from falling objects or any other kind of (*2*) ___________.

The reinforcement is usually made of a composite material, or a (*3*) ___________ such as thermoplastic polyurethane (TPU). Safety boots are important in the (*4*) ___________ industry and in many industrial settings. Professional safety boots usually need (*5*) ___________. Sometimes the certification is displayed directly on the boots. In Canada, for example, certified boots have a Canadian Standards Association green triangle on them. In the United States most safety shoes have (*6*) ___________ on the outside, to indicate the kind of protection the shoe offers. For example:

- — Green Triangle indicates that it is a class 1 toe cap with puncture resistant sole;
- — Yellow Triangle indicates that it is a class 2 toe cap with puncture resistant sole;
- — White Square (with ohm symbol) indicates electrical protection;
- — Yellow Square (with SD) indicates anti-static protection;
- — Red Square (with C) (*7*) ___________ electrically conductive protection;
- — Fir Tree indicates protection against chain-saws.

E. __________________________

• noise • object • invented
• manufacturers • protection • building

This item is an (*1*) ___________ designed to cover person's ears for (*2*) ___________. They were (*3*) ___________ in the 19th century. They consist of a thermoplastic or metal head-band, that fits over the top of the head, and a pad at each end, to cover the external ears. Each ear-cap contains special material to reduce (*4*) ___________. Ear defenders may be carried on a head-band or clipped onto the sides of a hard hat, for use on (*5*) ___________ sites. Nowadays some (*6*) ___________ combine headphones with ear defenders, allowing the worker to listen to a music and also enjoy protection from external noise.

3. Answer the following questions about the text above.

A.

1. What are the spheres of usage of helmets?
2. What are helmets made of?

3. What is a visor?
4. What does a hard hat protect you from?

B.

5. What are the two terms for a piece of clothing that protects our body?
6. Do only men wear boiler suits?
7. What are boiler suits usually made of? Why?

C.

8. What are the spheres of usage of goggles?
9. What are the requirements for industrial goggles?

D.

10. What are safety boots used for?
11. What is the purpose of certification of safety boots in the USA?
12. How many colours are used in US certification of safety boots? What are they?

E.

13. When were ear defenders invented?
14. What is special about modern types of ear defenders?

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_9/)

1. ______________________________

(00:57)

Watch the video, answer the following questions, and do the following assignment.

1. *What is the main idea of the track?*
2. *Think of a title to the track.*

2. THE 3 VIDEOs

(Video 1, Video 2, Video 3)

Pre-listening

1. *What pieces of safety equipment do you remember?*
2. *What do we need each of these pieces of safety equipment for?*
3. *Who usually needs to use safety equipment?*

While-listening

Watch the three videos and complete the table.

	Video 1	Video 2	Video 3
Sphere of usage			
Order of safety equipment presented in the videos			

Video 1 — "Welding safety equipment"

(02:46)

Watch the first video and answer the following questions.

4. *What is the speaker's job?*

5. *What does a "welding hat" mean?*
6. *What is the purpose of a welding hat?*

Video 2 — "Firework safety equipment" (01:33)

Watch the second video and answer the following questions.

7. *What is the speaker's job?*
8. *What is his name?*
9. *What is another expression for "safety equipment" used in the track?*
10. *What is the purpose of gloves in dealing with fireworks?*
11. *What is the speaker's wish to the people who use fireworks?*

Video 3 — "Carpentry safety equipment" (02:53)

Watch the third video and answer the following questions.

12. *What is the speaker's job?*
13. *What is his name?*
14. *What are different kinds of masks?*
15. *What is the purpose of gloves in carpentry?*
16. *What is the basic rule to work with a special table (with power, or electric blade)?*
17. *Why do carpenters need "a push-block" and "a push-dig"?*

Post-listening

18. *Compare safety equipment of these three professions. Which pieces of safety equipment are used by each of these workers and which are special? Is there any piece of equipment that wasn't mentioned, but you think it is important for the particular job? Why?*

3. SAFETY EQUIPMENT FOR CAVERS (01:19)

Watch the video and answer the following questions.

1. *What safety equipment does the caver have?*
2. *What other pieces of safety equipment may a caver need?*

Watch the video again and fill in the gaps in the text.

Before you go in a cave, don't go alone, and don't go without any guide. It's very, very (*1*) ___________. It's very (*2*) ___________. It's very important to (*3*) ___________ the caves with a (*4*) ___________ guide who knows the cave very well.

If you go in a cave, first you have to take notes where you are going, who with, and the other thing to be (*5*) ___________ and fit—someone should know that you are in a cave, and you have to predict (*6*) __________ when you come back; may be (*7*) ___________ hours later, because if you don't come back in (*8*) ___________ hours, the rescue team can come and rescue you.

You can take (*9*) ___________. But sometimes if you find water in a (*10*) ___________, you are lucky, because it is ... drinkable.

But it's also good to bring some water, because on your way ... you can loose some water from your ..., some humidity from your (*11*) ___________. And it's (*12*) ___________, because in a wet cave you can't feel like you are thirsty, but you have to (*13*) ___________ every (*14*) ___________ or (*15*) ___________ hours.

10. PROFESSIONAL DISEASES

Part I

1. **What do you think is Repetitive Strain Injury? How do you understand the phrase? What is the equivalent phrase in your own language?**
2. **Read the following text and match the headings (A–D) with the paragraphs (1–3). There is one extra heading that you do not need to use.**

A. Advice for computer workers.
B. Advice for factory workers.
C. General advice.
D. What is RSI?

REPETITIVE STRAIN INJURY (RSI)

1. ______

Any person who repeats the same movement a lot of times can develop repetitive strain injury. Factory workers, computer operators, sports people, and musicians are at the most risk because their jobs involve making the same movement thousands of times. The **symptoms** of RSI include: pain and/or burning in the damaged area, difficulty in moving, and loss of feeling.

2. ______

It is difficult to **cure** RSI but you can avoid it before it starts. To **prevent** RSI, workers at risk should:

— take regular breaks from their work to stretch and move about;

— learn to sit and move correctly so they use their bodies naturally.

3. ______

People who use computers for a long time have a high **risk** of developing RSI. Here are some basic rules for working safely at a computer:

— take regular breaks to stretch and relax;
— move the screen to eye level or a little bit lower;
— don't hold the mouse for too long or too tightly;
— sit with your back **relaxed**, shoulders down, and your neck straight;
— keep your wrists relaxed, your elbows at about 90 degrees, and the lower parts of your arms parallel to the desk top;
— use an **adjustable** chair;
— keep your feet flat on the floor.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 13*, *pg. 15*, *Ex. 2.*)

3. Read the text again and find the English equivalents to the following expressions.

Любой человек; находятся в зоне максимального риска; боль или жжение; затруднение двигательной функции; потеря чувствительности; (люди), находящиеся в зоне риска; походить (подвигаться); правильно двигаться; высокий риск развития синдрома; основные правила; уровень глаз; держите кисти рук расслабленными; регулируемый стул; стопы прижаты к поверхности пола.

4. Match the words in bold type in the text with the meanings below.

1	a danger	
2	can be moved into different shapes or positions	
3	signs of an illness	
4	stop something happening	
5	to make an illness better	
6	without tension or strain	

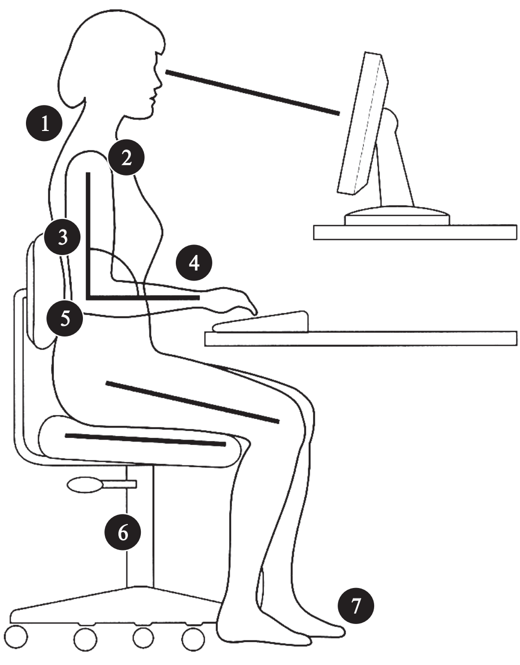
(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 13*, *pg. 15*, *Ex. 3.*)

5. Match the following words.

• level • RSI • an advice • naturally • feeling
• workers • relaxed • a disease • risk of RSI • to cure
• chair • rules • moving • on the floor • correctly
• safely • movements • breaks • risk • area

1	to give		11	basic	
2	computer		12	regular	
3	difficulty in		13	to keep	
4	to work		14	high	
5	to repeat		15	eye	
6	to prevent		16	to be at the most	
7	symptoms of		17	damaged	
8	to move		18	to keep flat	
9	adjustable		19	difficult	
10	loss of		20	to use the body	

6. Look at the diagram and match the labels (a–g) with the correct items (1–7).



(a) elbows at 90 degrees
(b) feet flat on the floor
(c) head and neck straight and relaxed
(d) lower arm horizontal
(e) shoulders down
(f) upper arm vertical
(g) use an adjustable chair

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 13*, *pg. 15*, *Ex. 4.*)

7. Answer the questions to the text above.

1. What does the term “RSI” stand for?
2. Who are at the most risk of RSI?
3. What are the symptoms of RSI?
4. Is it easier to prevent RSI or cure the disease?
5. What should people do to prevent RSI?
6. What are the rules of using a computer in order to prevent RSI?
7. What does the word “adjustable” mean?
8. Why is an adjustable chair so important?

8. Study the table below. Try to understand the meaning of each word in column 1 according to its definition in column 2. Don’t use English-Russian Dictionary! Write the translation in column 3. Compare it with your partner.

Parts of Human Body

1	2	3
ankle	the part of your body where your foot joins your leg	
arm	the long part at each side of your body connecting your shoulder to your hand	
calf	the back of your leg between your ankle and your knee	
cheek	either side of your face below eyes	
chest	the top part of the front of your body	
chin	the part of your face below your mouth	
elbow	the middle of your arm where bones of the arm join	
eye-brow	the line of hair above your eyes	
eyelash	one of the hairs that grow round your eyes	

1	2	3
eyelid	the piece of skin that can move and cover your eyes	
finger	one of the five parts at the end of each hand	
foot	the lowest part of the body at which a person stands	
fore-arm	the part of your arm between your elbow and your wrist	
fore-head	the part of your face above your eyes and below hair	
heel	the back part of your foot below your ankle	
hip	the part of the side of your body above your legs and below your waist	
jaw	bones in your face that contain your teeth	
knee	the place where your leg bends (like elbow)	
lip	two soft parts of your mouth	
nail	the thin hard thing that covers your fingers and toes	
neck	the part of your body that joins your head to your shoulders	
nostril	one of the two openings at the edge of your nose that you breath through	
palm	the flat inner surface of your hand	
shin	the bone at the front part of your leg from your knee to your ankle	
shoul-der	the part of your body between your neck and the top of your arm	
sole	the bottom of your foot that you stand on	
stom-ach	the front part of your body below your chest and above your legs	
thigh	the top part of your leg above your knee	
throat	the front part of your neck	
thumb	the short thick finger at the side of each hand	
toe	one of the small parts like fingers at the end of each foot	
waist	the narrowest part around the middle of your body	
wrist	the narrow part at the end of you arm where it joins your hand	

9. Try to give your own explanations to the following words.

ear	
eye	
hair	
hand	
leg	
mouth	
nose	

Check your answers.

10. Remember the following words that can help you explain different parts of human's body:

front/back — спереди/сзади;
below/above — снизу (ниже)/сверху (выше);
top/bottom — верх (наверху)/низ (внизу);
thin/thick — тонкий/толстый;
narrow/wide — узкий/широкий.

11. Find as many parts of human's body as you can (25 words). They may be written vertically, horizontally or diagonally.

	a	b	c	d	e	f	g	h	i	j
1	C	A	L	F	L	I	P	Z	Y	S
2	H	G	F	O	R	E	A	R	M	T
3	E	L	B	O	W	R	L	M	O	O
4	E	Y	E	T	R	I	M	D	U	M
5	K	N	E	E	G	E	A	R	T	A
6	W	W	N	W	X	C	H	H	H	C
7	R	V	A	R	M	H	A	E	Z	H
8	I	J	I	I	Y	E	I	E	A	V
9	S	O	L	E	S	S	R	L	R	D
10	T	H	R	O	A	T	H	U	M	B

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

REPETITIVE STRAIN INJURY

1. **Read the following text with gaps and match the headings with its parts (A—D).**

• Treatment • Symptoms
• Background information • Study

2. **Read the text again and fill in the gaps with the following words.**

• activity • instrument • pain
• strain • tool • arm • keyboard
• feeling • injury

A. ______________________________

Repetitive (*1*) ___________ injury (RSI), also known as Cumulative Trauma Disorder (CTD), is a professional overuse syndrome, non-specific (*2*) ___________ pain or *work-related upper limb* (= legs or arms) disorder (*WRULD*). Nowadays it is the well-known illness concept that links use of the arm to (*3*) ___________ or disease. Prior to typewriters or computers there was the concept of "writer's cramp" (= sudden pain in muscles, usually caused by cold or too much exercise).

The basis for this illness concept is the idea that one can overuse a (*4*) ___________, such as a computer (*5*) ___________ or musical (*6*) ___________ in a way that causes tissue (= muscles, nerves, brain) damage leading to pain. Conditions such as RSI tend to be associated with both physical and psychosocial stressors.

B. ______________________________

The following complaints are typical among patients that might receive a diagnosis of RSI:

— (*7*) ___________ in the arm (typically diffuse—i.e. spread over many areas);

— the pain is worse with (*8*) ___________;
— weakness, loss of (*9*) ___________.

The symptoms tend to be diffuse and non-anatomical. They tend not to be characteristic of any discrete pathological conditions.

• special • factors • doctors • prevent • reduce
• program • provide • software • improve
• risk • tests • cure • eight • increase • ergonomic

C. ______________________________

Diagnostic (*10*) ___________ (radiological, electrophysiological, etc.) are normal. In short, RSI is best understood as a healthy arm that hurts.

Studies have related RSI with psychological and social (*11*) ___________. A large amount of psychological distress showed doubled (*12*) ___________ of the pain. For example, poor support from colleagues and work dissatisfaction also showed an (*13*) ___________ in pain. So, some (*14*) ___________ believe that stress is the main cause of RSI. The main advocate of this point of view is Dr. John E. Sarno, Professor of Rehabilitation Medicine at the New York University Medical School.

D. ______________________________

Modifications of arm use (ergonomics) are often recommended.

Adaptive technology—from (*15*) ___________ keyboards, mouse replacements and pen tablet interfaces to speech recognition (*16*) ___________—might be necessary. “Pause” software reminds the user to pause frequently and/or perform practices while working behind a computer. One such (*17*) ___________ is Workrave, an open-source free programme that helps to (*18*) ___________ and (*19*) ___________ Repetitive Strain Injury. The programme frequently signals to the user to take micro-pauses, rest breaks and shows the user his/her daily limit. A kind of (*20*) ___________ keyboard, such as the Goldtouch solution, or a kind of ergonomic mouse, such as a RollerMouse, vertical mouse or joystick, may help and (*21*) ___________ relief.

Some people with RSI find relief in specific movement therapies such as taijiquan, t'ai chi ch'üan, yoga, or some other techniques that (*22*) ___________ the risk of developing RSI. Also, doctors often recommend to do different specific strengthening exercises, for example to (*23*) ___________ posture of your body.

Recovery is up (*24*) ___________ months before any activity should be used.

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_10/)

1. KEYBOARD ERGONOMICS

(0:39)

Pre-listening

1. *Do you remember the following words?*

   Wrist, straight, angle, to relieve, blood flow, to twist, adjustable.

2. *Do you understand the word "ergonomics"?*

While-listening

Watch the video **without inscriptions**, answer the following question, and do the following assignment.

3. *What is the main idea of the track?*
4. *Use the following words to make sentences about the video:*

   old-fashioned, develop, prevent, ergonomics.

Watch the video and **read the inscriptions**. Try to understand them.

5. *Translate the inscriptions. Translate the idea, not word for word.*

Post-listening

Watch the video **without inscriptions**.

6. *Try to comment on each episode. Use the following words.*

   00:*01* — wrist (hand), position
   00:*04* — straight, angle, inwards
   00:*08* — reduce pressure, risk
   00:*12* — vertically
   00:*17* — raise, blood flow
   00:*21* — natural position
   00:*26* — comfortable, standard keyboard
   00:*30* — adjustable keyboard

2. ____?

(01:23)

Pre-listening

1. Do you know the following words?

Individual, staff, user, disability, needs, customize, properly.

While-listening

Listen to the whole track **without video**.

2. What title can be given to the track?

Listen to **the parts** of the track **without video** and answer the following questions.

00:00—00:12

3. What is another word for "movement" used in the track?

00:13—00:24

4. Why are the words "hour", "day", "week" mentioned?

00:25—00:49

5. What does a "reason answer" to the RSI problem mean? How is it called?

6. What does "the Goldtouch solution" consist of?

Listen and watch the video again to check the answers.

7. Fill in the gaps in the following text.

00:00—00:25

RSI—repetitive (*1*) ___________ injury, (*2*) ___________ resulting from the (*3*) ___________ actions we all make when using IT (*4*) ___________.

Always it is caused by (*5*) ___________ and keyboard on a (*6*) ___________. Just picture yourself—crashed over the (*7*) ___________, thumping those (*8*) ___________, clicking the mouse, repeating the same (*9*) ___________ hour after hour, day after day, week after week.

00:26—00:56

What can you as an individual or as an (*10*) ___________ do to safeguard yourself and your staff against (*11*) ___________?

Well, reason answer ... is (*12*) ___________ and (*13*) ____________. It's called the Goldtouch (*14*) ____________ and consists of the Goldtouch (*15*) ___________ and the ... of software called the RSI-guard which together help (*16*) ___________ your own work activity.

I've been working with users with disabilities, so finding a successful (*17*) ___________ solutions for long for over (*18*) ___________ years.

I've found that the (*19*) ___________ is to recognize each person's computing needs a (*20*) ___________ individual.

01:01—end

The Goldtouch (*21*) ___________ is an (*22*) ___________ combination of (23) ___________ of a work management that can be (*24*) __________ customized by each user.

For you that means much in your work ... with your (*25*) __________ needs and, when you use it properly, (*26*) __________ ... __________ of a computer-related (*27*) ___________.

Post-listening

8. *Why do people suffer RSI?*
9. *Why is "the Goldtouch solution" called an "RSI-guard"?*
10. *Why is "the Goldtouch solution" so unique?*

3. RSI-PREVENTION (01:53)

Pre-listening

Answer the questions.

1. *How can we prevent RSI?*
2. *What things can help us prevent RSI?*
3. *Do you know the following words?*

   To click, to skip, instead of, to match, behaviour, restriction, customizable.

While-listening

Listen to the whole track **without video**.

4. *What is the idea of the whole text?*

Listen and watch **the parts** of the video and answer the following questions.

00:00—00:39

5. *What is the speaker's name?*
6. *What are the elements of RSI-preventing helpers?*

00:40—00:50

7. *What is "break-timing"?*

00:51—01:05

8. *What is a "short-cut"?*

01:06—01:15

9. *What is "data-looking"?*

01:16—01:29

10. *What is a "forget-me-not"?*

01:30 — end

11. *What is a "graph"?*
12. *How can we better understand the limits at our work?*

Listen and watch the video and fill in the gaps in the following text.

00:00—00:22

Hello, I'm Ameline (*1*) ___________. In the context of (*2*) __________ the expression "work management" is used to encompass the whole range of (*3*) __________, including (*4*) __________ posture, (*5*) __________ rates and rest rates, and ...—the monitoring and (*6*) __________ of this.

00:23—00:50

The Goldtouch RSI-guard is a ... of (*7*) ___________-timing prompts and video-styled (*8*) __________ which for the user can become his or her own work management expert.

RSI-guard contains a number of (*9*) ___________, all of which are fully customizable ... by the user or (*10*) ___________ wide. This include intelligent break-timing to remind you when to take breaks and for how long. If you are in a hurry, you can of course skip them but it all begins soon.

00:51—01:35

"Short-cuts" allow you to avoid unnecessary mouse (*11*) ___________, for instance, I can use any (*12*) __________, say, my function keys instead of the mouse (*13*) ___________ just to get the change of (*14*) ___________ or even to alter a click ... .

"Data-looking" automatically matches your (*15*) ___________ use and behaviour and suggests ways to work more efficiently ... .

"Forget-me-nots" and your own "go-hints" are customizable mini-breaks and suggestions for stretching exercises. This task-level (*16*) __________ training has been (*17*) ___________ to ensure you get a good workout while still sitting at your desk.

"Dynamic work restrictions" can be used to ensure the safe working practices over a day or (*18*) ___________.

01:36—01:46

And because of all your mousing (and keyboarding) is locked in graphs, you can begin better (*19*) ___________ your own (*20*) ___________ at your work and manage your own computer work float to (*21*) ___________ future (*22*) ___________.

Post-listening

13. Which of the above-mentioned RSI-preventing helpers are the most useful and why?
14. Can you think of any other RSI-preventing helpers?
15. Would you like to have such RSI-preventing helpers on your computer and why?

4. REPETITIVE STRAIN INJURY (08:04)

Pre-listening

Remember the answers to the following questions.

1. What is RSI?
2. Why do people suffer RSI?
3. What are the symptoms of RSI?

4. *How can we prevent RSI?*
5. *What are the rules of using a computer in order to prevent RSI?*
6. *Do you know the following words?*
   — Be familiar (= to know), overuse, precaution, behaviour, onset, vital (= very important), height, length, pillow.
   — Body movements—turn, bend, interlock, shrug, move, place, push, stretch, twist, fold, pull, circle, join, raise.
   — Forward, backward, upward, downward, inward, outward, sideways.
7. *While watching the video find the meaning of the following words.*
   pad, fist.

While-listening

Watch the video **part by part**, answer the following question and do the following assignment.

00:00—00:58

8. *What are usual repetitive tasks that cause RSI?*
9. *Fill in the gaps in the following part of the text.*

Today I'm going to talk to you about RSI—an abbreviation for repetitive strain injury. One thing of that could be: "OoooooHhh!", "AaaaaaHhh!", "AaoouuCh!". Now, these are (*1*) ___________ we are all familiar with. With long working hours, deadline targets, night shifts. It is normally to strain or overuse our (*2*) ___________. And fortunately most people are not informed and do not understand what RSI is.

Repetitive Strain Injury — potentially a ... condition resulting from (*3*) ___________ of muscles, tendons, and nerves, especially when you do (*4*) ___________ tasks such as (*5*) ___________, (*6*) ___________, or (*7*) ___________ a mouse.

00:59—01:26

10. *Make a list of the main risks.*
11. *Compare your list and the suggested list. How many differences are there? Which of the risks you think is/are the most dangerous?*
12. *Think of the ways of how to prevent RSI.*

01:27—01:45

13. Watch the video and find out the other ways to prevent RSI.

14. Fill in the gaps in the following text.

How do we (1) ___________ RSI?...

...It is wise to (2) ___________ well, (3) ___________ regularly, listen to your (4) ___________ and avoid destructive (5) ___________. However, there are some (6) ___________ precautions you can take to help prevent the onset of (7) _________.

01:46—03:19

15. Watch the video ***without audio*** *and give comments on what you see, using the following words.*

Place, keep, adjust, easy to use position, comfortable sitting, forearms, elbows, screen, parallel, relaxed, at 90 degrees, in front of you, at eye level.

16. Watch the video ***with audio*** *and fill in the gaps in the following text.*

(1)

First and for most it is (*1*) ____________ to have a (*2*) ___________ work station. (*3*) ____________ your phone and mouse in an easy to use (*4*) ___________. ... your (*5*) ___________ is rested firmly on the ground.

(2)

Second it is vitally to maintain a good sitting (*6*) ___________. (*7*) ___________ the height of your chair, so that when you're working, your (*8*) ___________ are (*9*) ___________ to the floor and (*10*) ___________. While typing, make sure your (*11*) ___________ are at (12) ___________ degrees. Give a firm support to your lower (*13*) ___________. You may use ... or pillows for more comfort.

(3)

Third. Adjust your monitor (*14*) ___________. It should be (*15*) ___________ and directly in front of you. ... the distance is an arm's length position and also your eye-line is at the top third of your (*16*) ___________.

(4)

Fourth. Keep your (*17*) ___________ parallel to your desk while (18) ___________. Rest on soft key-pads if you are tired.

(5)

It is very important to take (*19*) ___________—every half an hour or so. Get up and (*20*) ___________ around. Get some (*21*) ___________ or look out of the (*22*) ___________.

03:20—07:01

17. *Watch the video* ***without inscriptions*** *and comment on each video part using the following words.*
    - — *Verbs*: join, raise, turn, bend, interlock, stretch, put, move, push, pull, place, form, circle, press;
    - — *Nouns*: palm, finger, back, shoulder, forearm, arm, wrist, chin, head, neck, hand, thumb;
    - — *Adverbs*: behind, backward, downward, sideways, upward, forward, in a prayer position.
18. *Watch the video* ***with inscriptions*** *and check yourself.*

07:02—end

19. *Watch the video and fill in the gaps in the following text.*

These (*1*) __________ are primately cured to ... a relieving or preventing the onset of RSI. In case you notice any (*2*) ___________ of RSI, please, take (*3*) ___________ help, (*4*) ___________ your physiotherapist immediately.

I hope you found the session (*5*) ___________ and you try and do a few exercises to (*6*) ___________ any health complications at work.

Thank you.

Post-listening

20. *What do the words "pad" (03:06—03:12) and "fist" (06:06—06:11) mean?*
21. *How many parts can the video be divided into?*
22. *What headings can be given to each part?*

11. OPTICAL FIBRES

Part I

1. **What properties do optical fibres have? Where are optical fibres used?**
2. **Read the following text quickly and choose the best title A, B or C.**

A. The history of cabling and telecommunications.
B. A short introduction to optical fibres.
C. Uses of glass in industry and technology.

Optical fibres started to replace some uses of copper cables in the 1970s. They are made from glass and are usually about 120 **micrometre**s in **diameter**. Some of the most common everyday uses are in telecommunications, close-curcuit television (CCTV), and cable television.

1. ____

Optical fibres carry signals more **efficiently** than copper cable and with a much higher bandwidth. This means that fibres can carry more channels of information over longer distances.

2. ____

Optical fibre cables are much lighter and thinner than copper cables with the same bandwidth. This means less space is needed in underground cabling **ducts**.

3. ____

It is difficult to steal information from optical fibres. They are not harmed by electromagnetic interference, for example from radio signals or lighting. They don't **ignite** so they can be used safely in **flammable** atmospheres, for example in petrochemical plants.

4. ____

Optical fibres are more expensive **per** metre than copper. However, one optical fibre can carry many more signals than a single copper cable and the longer transmission distances mean that fewer expensive repeaters are required. Also, copper cable uses more electrical power to deliver the signals.

5. ____

Optical fibres can't be spliced as easily as copper cable. Employees need special training **to handle** the expensive **splicing** and measurement equipment.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 14*, *pg. 16*, *Ex. 2.*)

3. Read the text again and match the headings (A–E) with the paragraphs (1–5).

A	Training and skills	
B	Size and weight	
C	Security	
D	Price	
E	Capacity	

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 14*, *pg. 16*, *Ex. 3.*)

4. Which paragraphs describe *advantages* of optical fibres and which describe *disadvantages*?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 14*, *pg. 16*, *Ex. 4.*)

5. Read the text again and find the English equivalents to the following expressions.

Начали вытеснять; некоторые способы использования; сделано из; примерно; повседневное использование; проводят сигналы;

легче и тоньше, чем; требуется меньше пространства; электромагнитные помехи; могут быть безопасно использованы; один-единственный; дорогостоящие ретрансляторы (передатчики); так же легко, как; специальное обучение; измерительное оборудование.

6. Complete the definitions below with the words in bold type in the text.

1. A ___________ is one million of a metre.
2. The ___________ is the distance across a circle.
3. A ___________ substance is one that burns easily.
4. "___________" means joining the ends of two cables together.
5. To "___________" means to start to burn.
6. ___________ are tubes for carrying cables.
7. "___________" is a common short way of saying "for each".
8. To "___________" means to touch with your hands.
9. "___________" means in a way that produces a good result and doesn't waste time, energy, or resourses.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 14*, *pg. 16*, *Ex. 5.*)

7. Guess the words from their definitions and find them in the text.

1. Material that is used to carry light and coded messages.
2. A clear hard material used for manufacturing windows, bottles, etc.
3. A line across a circle.
4. A way along which news, information is sent.
5. The amount of space between two places or things.
6. The place where Metro is situated.
7. Facts or details about something or somebody.
8. A piece of equipment used for listening to different programs.
9. An adjective used to characterize anything that ignites easily.
10. It means "to cost much money".
11. People who work at a plant, for a company, etc.
12. Special things that you need to do something.

8. Guess the following words from the text as it is shown in the example: *illsk = skill.*

bleca	dlehan
ppcoer	teigni
calopti	widthband

remetdia blemmafla
ryrca licingsp

9. Study the following words and make as many word phrases as you can.

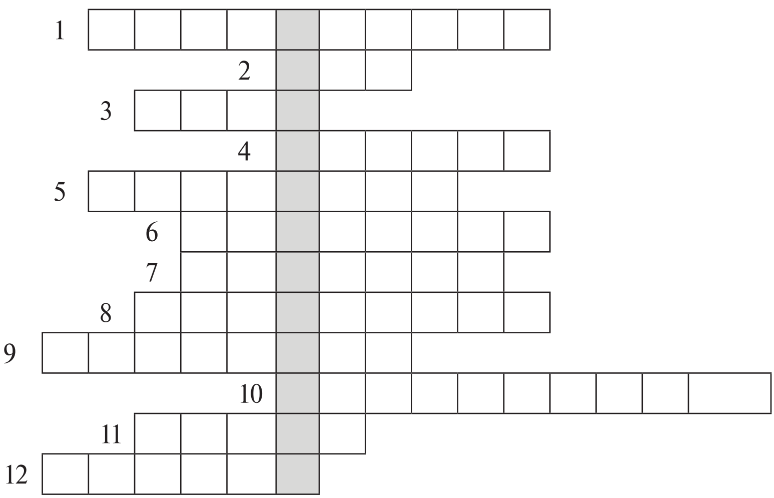
Optical, special, copper, micrometer, expensive, cable, deliver, measurement, high, long, electromagnetic, radio, flammable, petrochemical, per ..., electrical, fibre, training, in diameter, splicing, TV, signal, equipment, bandwidth, distance, interference, a signal, atmosphere, plant, metre, power.

10. Match the following words with the words from Ex. 9.

1	optical		9	high	
2	special		10	long	
3	copper		11	electromagnetic	
4	micrometer		12	radio	
5	expensive		13	flammable	
6	cable		14	petrochemical	
7	deliver		15	per	
8	measurement		16	electrical	

11. Try to make sentences about optical fibres with the matched word phrases from Ex. 10.

12. Do the crossword. What is hidden on the vertical highlighted line?



1. Copper cables are usually about 120 ... in diameter.
2. The speed limit in Russia is 90 kilometres ... hour.
3. A pipe or a tube that carries liquid, gas, electric, or telephone wire.
4. To start to burn; to make something start to burn.
5. The amount of something that a certain container can hold.
6. A line across a circle.
7. To take something (ex. letters) to the place according to the address.
8. An opposite to the word “easy”.
9. A line of pipes that are used for carrying liquid or gas over a long distance (usually underground).
10. Amount of information that a particular computer network or Internet connection can send in a second.
11. When you take something in your hand and move from one place to another; a synonym to “conduct” electricity.
12. To control or manage something; to work with something; to deal with something (a problem, task, etc.); to touch with your hands.

13. Fill in the gaps in the sentences (1–20) with the following words.

• ignite • distance (×2) • pipes • measurement
• bandwidth (×2) • splice • duct • deliver
• delivery • handle (×3) • harm (×2)
• pipeline • capacity (×2) • diameter

1. Be careful with those chemicals—they __________ easily.
2. Nowadays old-fashioned __________ used for water are replaced by plastic ones.
3. Drivers should keep __________ on the road.
4. Elina has a good __________ for hard work.
5. Optical fibres __________ signals more efficiently.
6. Wash your hands before you __________ food.
7. DHL is a well-known __________ company.
8. Please, draw the ___________ of the circle accurately.
9. RSI development can ___________ your health.
10. The ___________ of this hall is 500 people.
11. People get gas with the help of ___________.

12. The map tells you the ___________ between major cities.
13. It is too stuffy in the room. The air ___________ should be repaired.
14. Accurate ___________ is very important in science.
15. Chemicals are dangerous to ___________. Don't touch them!
16. What is the ___________ of your Internet? Isn't it too slow?
17. Don't forget to use an adjustable chair while working in order not to ___________ your health.
18. To "___________" means to join together two pieces of wood, magnetic tape, film, etc.
19. Engineers know how to ___________ (= manage, control) different problems.
20. The amount of information that can be sent by a computer in a particular time is called "___________".

14. Translate the following sentences into Russian. Translate the idea, not word for word.

1. What is the bandwidth of your Internet?
2. "Can I use your computer to log in?"—"Yes, but the bandwidth is very low".
3. How much money do you pay for this kind of bandwidth?
4. The workers got into the building through the air duct.
5. One of the air ducts has gone wrong and that is why it is very hot indoors.
6. Please can you measure accurately?
7. A special stick is used to measure how much oil is left in an engine.
8. Please find out the measurement of this piece of equipment.
9. This stadium has got a capacity for 20,000 people.
10. The capacity of this hall is 500 people.
11. Her capacity for accurate drawing helped her to get a good mark on exam.
12. Your order will be delivered within five days.
13. We deliver the equipment free within the local area.
14. Does your company have a service of delivery on Sundays?
15. This company has over 50 deliveries per day.
16. Did you deliver the message to the Head of the Engineering Department?

17. I don't know how to handle this equipment.
18. This car is difficult to handle.
19. There is a sign "Handle with care".
20. What is the diameter of traffic signs?
21. Too much sun can harm your skin.
22. The implant in her body didn't do any harm to her health.
23. Implants must be put in accurately or they can harm you.
24. Development of RSI can harm your health.
25. Use an adjustable chair or it can harm your body.
26. Copper pipe is sold in length.
27. What is the name of the main pipeline in Russia?
28. People get gas with the help of pipelines.
29. The plant is within walking distance.
30. Can you see the number of the bus at this distance?
31. This company delivers goods to long distance.
32. There is a traffic sign "Keep your distance!".
33. Petrol ignites easily.
34. Be careful with these chemicals, they ignite easily.
35. Try to splice these pieces of plastic accurately.
36. The magnetic tape was spliced accurately.

Check the knowledge of active vocabulary from this part with the help of "ACTIVE VOCABULARY" section.

Part II

1. OPTICAL FIBRE

1. **Read the following text with gaps and match the headings with its parts (A—E).**

• Types • Usage • Joining together
• Description • History

2. **Read the text again part by part and fill in the gaps with the following words.**

• signal • system • communications
• carries • light • message

Nowadays optical fiber is the most common type of channel for optical (*1*) ___________. Optical communication is any form of telecommunication that uses (*2*) ___________ as the transmission medium. An optical communication (*3*) ___________ consists of a *transmitter*, which encodes a message into an optical (*4*) ___________, a *channel*, which (*5*) ___________ the signal to its destination, and a *receiver*, which reproduces the (*6*) ___________ from the received optical signal.

A. ________________________________

• cable • light • transparent
• protective • ducts • distance
• glass • made • plastic • diameter

An optical fiber cable is a cable containing one or more optical fibres. An optical fiber (or fiber) is a (*7*) ___________ or plastic fibre that carries (*8*) ___________ along its length. The optical fibre elements are typically individually coated with (*9*) ___________ casing and are contained in a (*10*) ___________ tube suitable for the environment where the cable will be deployed.

Fibers can be made out of (*11*) ___________ (or clear) plastic, glass, or a combination of the two. The fibers used in long-(*12*) ___________ telecommunications are always (*13*) ___________ of glass.

Fibre (*14*) ___________ can be very flexible, but traditional fiber's loss increases greatly if the fibre is bent with a (*15*) ___________ smaller than around 60 mm. Usually optical fiber cables are put into the underground cabling (*16*) ___________.

B. ______________________________

• used • diameter • short
• single • meters

Fibers which support many propagation paths or transverse modes are called multi-mode fibers (MMF), while those which can only support a (*17*) ___________ mode are called single-mode fibers (SMF). Multi-mode fibers generally have a larger core (*18*) ___________, and are used for (*19*) ___________-distance communication links and for applications where high power must be transmitted. Single-mode fibers are (*20*) ___________ for most communication links longer than 550 (*21*) ___________ (1,800 ft).

C. ______________________________

• property • optical • modern • century
• Paris • physicist • technology
• 1870 • demonstrated • experiments

Fiber optics, though used extensively in the (*22*) ___________ world, is a fairly simple and old (*23*) ___________. Guiding of light by refraction, the principle that makes fiber optics possible, was first (*24*) ___________ by Daniel Colladon and Jacques Babinet in (*25*) ___________ in the early 1840s.

John Tyndall included a demonstration of it in his public lectures in London a dozen years later. Tyndall also wrote about the (*26*) ___________ of total internal reflection in an introductory book about the nature of light in (*27*) ___________: "When the light passes from air into water, the refracted ray is bent *towards* the perpendicular... When the ray passes from water to air, it is bent from the perpendicular..."

Practical applications, such as close internal illumination during dentistry, appeared early in the 20th (*28*) ___________. Image transmission through tubes was demonstrated independently by the radio experimenter Clarence Hansell and the television pioneer John Logie Baird in the 1920s. The principle was first used for internal medical examinations by Heinrich Lamm in the following decade. In 1952, (*29*) ___________ Narinder Singh Kapany conducted (*30*) ___________ that led to the invention of optical fiber. Modern (*31*) ___________ fibers, where the glass fiber is coated with a transparent cladding to offer a more suitable refractive index, appeared later in the decade.

D. ________________________________

• harmed • metal • bandwidths
• ignite • electricity • communications
• equipment • carry • space • repeaters

Optical fibers are widely used in fiber-optic communications, which permits transmission over longer distances and at higher (*32*) ___________ (data rates) than other forms of communications. Fibers are used instead of (*33*) ___________ wires because signals travel along them with less loss.

Over short distances, such as networking within a building, fiber saves (*34*) ___________ in cable ducts because a single fiber can (*35*) ___________ much more data than a single electrical cable. Fibers are also not (*36*) ___________ by electromagnetic interference; there is no cross-talk between signals in different cables and no pickup of environmental noise. Non-armored fiber cables do not conduct (*37*) ___________, which makes fiber a good solution for protecting communications (*38*) ___________ that is located in high-voltage environments such as power generation facilities, or metal communication structures prone to lightning strikes. They can also be used in environments where explosive fumes are present, as they don't (*39*) ___________ and there is no danger of ignition.

Optical fiber can be used as a medium for telecommunication and networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance (*40*) ___________, because light propagates through the fiber with little attenuation compared to electrical cables. This allows long distances to be spanned with few (*41*) ___________.

• large • equipment • building • Industrial
• analyze • environment • illumination
• objects • used • level • designed

Fibers are also widely used for (*42*) ___________. Optical fiber illumination is also used for decorative applications, including signs, art, and artificial Christmas trees. Swarovski boutiques use optical fibers to illuminate their crystal showcases from many different angles while only employing one light source.

In some buildings, optical fibers are used to route sunlight from the roof to other parts of the (*43*) ___________. Specially (*44*) ___________ fibers are used for a variety of other applications, including sensors and fiber lasers.

They are used as light guides in medical and other applications where bright light needs to be shone on a target without a clear line-of-sight path.

Optical fiber is also used in imaging optics. A coherent bundle of fibers is used, sometimes along with lenses, for a long, thin imaging device called an endoscope, which is used to view (*45*) ___________ through a small hole. Medical endoscopes are used for minimally invasive exploratory or surgical procedures (endoscopy). (*46*) ___________ endoscopes are used for inspecting anything hard to reach, such as jet engine interiors.

In spectroscopy, optical fiber bundles are (*47*) ___________ to transmit light from a spectrometer to a substance which cannot be placed inside the spectrometer itself, in order to (*48*) ___________ its composition. A spectrometer analyzes substances by bouncing light off of and through them. By using fibers, a spectrometer can be used to study objects that are too (*49*) ___________ to fit inside, or gases, or reactions which occur in pressure vessels.

Optical fiber can be used to supply a low (*50*) ___________ of power (around one watt) to electronics situated in a difficult electrical (*51*) ___________. Examples of this are electronics in high-powered antenna elements and measurement devices used in high-voltage transmission (*52*) __________.

E. ______________________________

• used • screen • copper • special
• process • together • temperature
• instrument • controlled

Fibre splicing is much more difficult than splicing (*53*) __________ wire.

Joining lengths of optical fiber is more complex than joining electrical wire or cable. The ends of the fibres must be carefully cleaved, and then spliced together either mechanically or by fusing them together with an electric arc. Special connectors are used to make removable connections.

As it has already been mentioned, optical fibers may be connected to each other by connectors or by *splicing*, that is, joining two fibers (*54*) __________ to form a continuous optical waveguide. The generally accepted splicing method is arc-fusion splicing, which melts the fiber ends together with an electric arc. For quicker fastening jobs, a "mechanical splice" is (*55*) __________.

Fusion splicing is done with a specialized (*56*) __________ that typically operates as follows: the two cable ends are fastened inside a splice enclosure that will protect the splices, and the fiber ends are stripped of their protective polymer coating. The ends are cleaved (or cut) with a precision cleaver to make them perpendicular, and are placed into (*57*) __________ holders in the splicer. The splice is usually inspected via a magnified viewing (*58*) __________ to check the cleaves before and after the splice. The splicer uses small motors to align the end faces together, and emits a small spark between electrodes at the gap to burn off dust and moisture. Then the splicer generates a larger spark that raises the (*59*) __________ above the melting point of the glass, fusing the ends together permanently. The location and energy of the spark is carefully (*60*) __________ so that the molten core and cladding don't mix, and this minimizes optical loss. A splice loss estimate is measured by the splicer, by directing light through the cladding on one side and measuring the light leaking from the cladding on the other side. A splice loss under 0.1 dB is typical. The complexity of this (*61*) ___________ is rather obvious.

3. Read the text again and find out if the following sentences are true (T) or false (F).

1	The usage of optical fibre is the only way to transmit signals nowadays.	T	F
2	There are three components in the system of optical communication.	T	F
3	Optical fibres are made of one material only.	T	F
4	Usually there are several fibres in a cable.	T	F
5	Optical cables are usually located underground.	T	F
6	There are many kinds of optical fibres.	T	F
7	Optical fibres appeared in Europe.	T	F
8	Optical fibres appeared over a century ago.	T	F
9	Optical fibres are used for exchanging information only.	T	F
10	There are two ways of splicing optical fibres.	T	F

4. Read the text again and answer the following questions.

1. What is optical communication?
2. What are the components of an optical communication system?
3. What are the functions of these components?
4. What are optical fibres usually made of?
5. What is the difference between MMF and SMF?
6. How long is the history of optical fibres?
7. What are the spheres of usage of optical fibres?
8. What are two usual ways of splicing of optical fibres?

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_11/)

1. FIBRE CABLE
(00:24)

Pre-listening

1. *What is optical fibre used for?*
2. *What are the spheres of usage of optical fibre?*
3. *What is optical fibre made from?*
4. *Study the meaning of the following words.*

   Jacket = an outer cover around something (ex. a pipe);
   buffer = a protector = a thing that protects something more important;
   cladding = a covering of a hard material, used as protection;
   core = the most important and central part of something.

   Which of these words have a similar meaning and generally one purpose?

While-listening

Watch the video and answer the following questions.

5. *How many elements does the cable in the track consist of?*
6. *What are they?*

Post-listening

7. *Try to remember the elements of the cable and tell about its structure without watching the video.*

2. OPTICAL TRANSMISSION TECHNOLOGY
(01:35)

Pre-listening

1. *What is optical fibre?*
2. *What is optical fibre used for?*

3. *What are the advantages of optical fibre usage?*
4. *Do you know the following words? Study the meaning of the words.*
   network, data, to consume, fluctuation.

While-listening

Watch the video and answer the following questions.

00:00—00:46

5. *Why is it a growing need for the development of optical communication network?*
6. *What bandwidth is being discussed nowadays as the way to upgrade the existing system?*
7. *When did the development of the world first 40 Gbps technology begin?*

00:47—01:05

8. *Who is the speaker and what does he do?*

01:06—end

9. *How is the optical transmission module characterized?*
10. *How much electricity does it consume?*
11. *How many modules of this kind have been produced?*
12. *Why was a test organized?*

Post-listening

13. *Complete the summary of the video track. Fill in the gaps with suitable words.*

There is a growing need for the optical (*1*) ___________ network with larger data transmission (*2*) ___________. Optical networks have to connect each home. Nowadays an optical communication (*3*) ___________ with a transmission capacity of 40 Gbps is being (*4*) ___________. The development of the world first 40 Gbps optical transmission (*5*) ___________ began in 2006. The optical transmission (*6*) ___________ is much more compact than any other transmitter. It consumes only 35 watt of (*7*) ___________. There have been produced 100 modules of this kind. A special (*8*) ___________ was organized to make sure that the module works reliably under operational (*9*) ___________ changes due to fluctuations and (*10*) ___________ and power supply (*11*) ___________.

3. HOW THE OPTICAL FIBRE SYSTEM WORKS (02:47)

Pre-listening

1. *What is optical fibre?*
2. *What is optical fibre used for?*
3. *Can you explain what "optical fibre system" is?*
4. *Can you think of how many elements are involved in this system and what are they?*
5. *Do you know the following words? Study the meaning of the words.*

   A medium, to simplify, setting, to code (information), to encode/to decode.

While-listening

Watch the video and answer the following questions.

6. *What is the optical fibre called by the speaker?*
7. *What analogy is used to simplify the idea of an optical fibre transmission?*
8. *What historical event is mentioned in the track?*
9. *What does the speaker demonstrate on a diagram?*
10. *How many elements are shown on the diagram? What are they?*
11. *What is the purpose of each element?*
12. *Watch and listen to the following part of the video track and fill in the gaps in the following text with the words you hear.*

00:35—01:24

So, put yourself in a (*1*) ___________ World War II setting. You are on a (*2*) ___________. It's (*3*) ___________, and it's (*4*) ___________, and it's (*5*) ___________. And you want to (*6*) ___________ another ship, so you can, perhaps, ask for some (*7*) ___________, using your telescope. So, you search for a ship, you try to find one ... and... There! You find a ship! Immediately you (*8*) ___________ the captain that ship is nearby. The (*9*) ___________ sends a (*10*) ___________ to the (*11*) ___________ to (*12*) ___________ to the other ship. The sailor runs up to the deck and transmits the (*13*) ___________ using a handy flashlight into a Morse code. So, the sailor on the other ship (*14*) ___________ the Morse code (*15*) ___________ and (*16*) ___________ it to the captain of the other ship. And they go back and forth. So, you get the point!

13. *What does the word "flashlight" mean?*

Post-listening

14. *Try to make your own summary of the video track and tell about the process of how optical fibre system works.*

4. HOW DOES OPTICAL FIBRE WORK? (03:33)

Pre-listening

1. *Do you know the following words? Study the meaning of the words.*

To spell, solid, to extend, angle, to coat/to be coated.

While-listening

Watch the video and answer the following questions.

2. *Why does the speaker mention Britain and America?*
3. *Why did the speaker draw a triangle on the board?*
4. *Where is the principle of a prism used? What for?*
5. *What is the idea of a prism called?*
6. *At what angle does the idea of a prism work?*
7. *Do we have the same situation with optical fibres?*
8. *Can we say that optical fibre is a tube?*
9. *Why are the optical fibres coated?*
10. *What is the most common use of optical fibres?*
11. *What other sphere of usage is mentioned?*

Post-listening

12. *Watch and listen to the video track again. Try to understand everything the speaker is talking about. Try to make a summary of what he tells.*

12. TUNNELS, DAMS, AND CANALS (CHANNELS)

Part I

1. How many different dams or tunnels can you think of?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 15*, *pg. 17*, *Ex. 1.*)

2. Read the text quickly and decide which structure it describes.

A. The Hoover Dam.
B. The Arlberg Tunnel.
C. The Channel Tunnel.
D. The Golden Gate Bridge.

The ... ... is between Britain and France. It's more than 20 kilometres long. It was built by British and French engineers. They started on opposite sides and met in the middle under the sea. They used specially-designed tunnel boring machines (TBMs) to dig the tunnels through the rock under the seabed. TBMs are enormous machines for digging tunnels. The machines used to dig the main tunnels were about 8.5 metres in diameter and 250 metres long. Work started in 1987 and the teams met under the seabed in 1991. It is a rail tunnel. The first passenger train went through in 1994.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 15*, *pg. 17*, *Ex. 2.*)

3. Read the text again and find the English equivalents to the following expressions.

Более чем; был построен; противоположные стороны; специально спроектированные; сквозь горную породу; дно моря; метров в длину; железнодорожный туннель.

4. Read the text again and answer the questions below.

1. Where is it?
2. What is it?
3. How long is it?
4. Who built it?
5. How did they build it?
6. What are TBMs?
7. How big are TBMs?
8. How long did it take to build the tunnel?
9. When did it open?

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 15*, *pg. 17*, *Ex. 3.*)

5. First, underline the question words in Ex. 4. Then use them to complete the following questions.

1. ...many Roman roads are there in Europe?
2. ...designed St Paul’s Cathedral in London?
3. ...is the name of the famous bridge in San Francisco?
4. ...was the Eiffel Tower built?
5. ...is the Corinth Canal?

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 15*, *pg. 17*, *Ex. 4.*)

6. Find in the text from Ex. 2 the words that show places (= define where the things are) or direction.

7. Fill in one of the words below into the gaps in the following texts. Check the meaning of any new words in the glossary or your dictionary.

• across • around • between
• over • through • under

The Panama Canal is a 64 km waterway (*1*) ___________ the Atlantic and Pacific Oceans. Before the canal was opened, ships had to travel thousands of miles (*2*) ___________ South America. To build the canal, engineers had to dam a major river, and dig a channel (*3*) ___________ a mountain ridge.

Tower Bridge is an openable bascule bridge, designed by Horace Jones in 1886. It goes (*4*) ___________ the river Thames in London. Thousands of vehicles drive (*5*) ___________ it every day. Tall ships cannot pass (*6*) ___________ Tower Bridge, instead, the roadway parts and lifts to let them through.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 15*, *pg. 17*, *Ex. 5.*)

8. Try to make questions about the Kazan Underground and the Kazan Millennium Bridge (use Ex. 4 as an example). Then try to find answers to the questions.

9. Try to make small texts about the Kazan Underground and the Kazan Millennium Bridge. Use the following words and phrases:

was built • highly-skilled engineers • opposite sides • specially-designed • enormous machines • TBMs • to dig the tunnel • a rail tunnel • was opened • went through • over the river • between two sides • drive across the bridge • under the bridge, etc.

10. Make as many word phrases with the following words as you can. An example is given.

Example: **to dig**: to dig a tunnel, to dig a hole, etc.

• to dig • dam • passenger • tunnel • team • vehicle • opposite • enormous • under • seabed • canal • between • to build • bridge

11. Match the words from Ex. 10 with their definitions below.

1	A passage under the ground.	
2	To move earth and make a hole in the ground.	
3	It means “very, very big”, “huge”.	
4	A group of people who work together, or play a game together against another group.	
5	It means “in a position on the other side of something”.	
6	A person who is travelling in a car (bus, train, plane, etc.) but who is not driving it.	
7	It means “the floor of the sea”, “the bottom”.	
8	Something that transports people or things from place to place (cars, bicycles, lorries, buses).	
9	It means “in the space in the middle of two things”—people, places, objects, etc.	

10	A long narrow piece of high land along the top of hills or mountains.	
11	To make something by putting pieces, materials, etc., together.	
12	It means “in a position that is below something”.	
13	A wall built across a river to hold back the water.	
14	A deep cut that is made through land and filled with water for boats or ships to travel along.	

12. Fill in the gaps with suitable words from the module.

1. Look at this dam! It’s ...!!!
2. A new modern ... was built across the river.
3. A train disappeared into a ... .
4. TBMs are used to ... tunnels.
5. Which ... has won the building project?
6. There was a beautiful building on the ... side of the street.
7. What kind of ... is used to transport TBMs?
8. The train goes ... this tunnel in 5 minutes.
9. The bridge is not very high, so tall ships can’t pass ... it.
10. A lot of ... usually travel in the train through the tunnel.

13. Translate the following sentences into Russian. Translate the idea, not word for word.

1. The company has just finished building a new tunnel.
2. A new tunnel has just been designed by a group of young engineers.
3. Builders brought special equipment to dig the ground.
4. TBM is a special digging machine.
5. To build a tunnel builders dig the ground with the help of TBMs.
6. Builders need special equipment to dig tunnels.
7. TBM is an enormous machine.
8. Special enormous machines are used to dig tunnels.
9. It is important to work in a team.
10. This building was designed by a team of highly-skilled engineers.
11. These two buildings are located on opposite sides of the river.

12. Look! Our new Top Manager is sitting opposite the boss.
13. The Head of the Engineering Department was the first passenger on that train.
14. The first passenger train was designed many years ago.
15. Sometimes tunnels are built under the seabed.
16. Are you the owner of this vehicle?
17. What vehicles do you use to transport special equipment to a building site?
18. Tower Bridge goes across the river Thames in London.
19. The Millennium Bridge in Kazan goes over the Kazanka River and joins the opposite sides of the city.
20. Building of dams is a very difficult but important process.
21. Safety is very important in the process of building tunnels, dams, etc.
22. Let me show you around the building site.
23. The ship went under the bridge.
24. The train goes through this tunnel in seven minutes.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. TUNNELS

1. Read the text and fill in the gaps with the following words.

• rail • built • underpass • machinery
• tunnel • risk • transport • vehicles
• define • telecommunications • project

A (*1*) __________ is an underground passageway. The definition of what constitutes a tunnel is not universally agreed upon. Tunnels in general, however, are at least twice as long as they are wide. In addition, they should be completely enclosed on all sides, safe for the openings at each end. Some civic planners (*2*) __________ a tunnel as 0.1 miles (0.16 km) in length or longer, while anything shorter than this should be called an underpass. For example, the (*3*) __________ under Yahata Station in Kitakyushu, Japan, is only 0.08 mi long (420 ft; 0.13 km) and therefore should not be considered a tunnel.

A tunnel may be for pedestrians (= people who are walking in the street) or cyclists; for general road traffic; for motor (*4*) __________ only; for (*5*) ___________ traffic; or for a canal. Some are aqueducts, constructed for carrying water—for consumption, for hydroelectric purposes or as sewers. The others may carry other services such as (*6*) ___________ cables. There are even tunnels designed as wildlife crossings for European badgers (= small animals with black and white lines on their head that live in holes in the ground and come out at night) and other endangered species. Some secret tunnels have also been made as a method of entrance or escape from an area, such as the Cu Chi Tunnels or the tunnels connecting the Gaza Strip to Egypt. Some tunnels are not for (*7*) ___________ at all, but they are more like fortifications (= walls or towers to protect a place from attack), for example Mittelwerk and Cheyenne Mountain.

In the United Kingdom, a pedestrian tunnel or other underpass under a road is called a subway. This term was used in the past in the United States, but now refers to underground rapid transit systems.

The central part of a rapid transit network is usually (*8*) __________ in tunnels. To allow non-level crossings, some lines run in deeper tunnels than others. Rail stations with much traffic usually provide pedestrian tunnels from one platform to another, though others use bridges.

It is essential that any tunnel (*9*) __________ starts with a comprehensive investigation of ground conditions. The results of the investigation will allow proper choice of (*10*) __________ and methods for excavation (= digging) and ground support. And this will reduce the (*11*) __________ of unforeseen problems that may occur.

• serious • users • long
• simple • smoke • construction
• materials • traditional • toxic

Tunnels are dug in various types of (12) __________, from soft clay to hard rock. So, the method of excavation depends on the ground conditions. Cut-and-cover is a (13) __________ method of (14) __________ for shallow (= not deep) tunnels where a trench (= a long narrow hole that is dug in the ground for water to flow along) is excavated and roofed over. Two basic forms of cut-and-cover tunnelling are available—bottom-up method and top-down method.

Large cut-and-cover boxes are often used for underground metro stations, such as Canary Wharf tube (= Underground) station in London. This construction form generally has two levels, which allows economical arrangements for ticket hall, station platforms, passenger access and ventilation, smoke control, staff rooms, and equipment rooms. The interior of Canary Wharf station has been likened to an underground cathedral. This contrasts with most (15) __________ stations of London Underground, where bored (= excavated) tunnels were used for stations and passenger access.

The (16) __________ of tunnels may also suffer different types of hazards. One of them, and the most (17) __________ one, is fire. That happens because of the enclosed space of a tunnel. The main dangers are gas and (18) __________ production, with low concentrations of carbon monoxide being highly (19) __________. Fires killed 11 people in the Gotthard tunnel fire of 2001, for example. Over 400 passengers died in the Balvano train disaster in Italy in 1944, when the locomotive broke down in a (20) ___________ tunnel. Carbon monoxide poisoning has been the main cause of the horrifying death rate. Fires have also occurred in the Channel Tunnel, leading to great delays for users.

2. Read the text again and find out if the following sentences are true (T) or false (F).

1	There is only one definition of the word “tunnel”.	T	F
2	An underpass is shorter than a tunnel.	T	F
3	Tunnels are made only for vehicles.	T	F
4	The word “subway” means the same in the UK and the USA.	T	F
5	The construction of a tunnel depends much on the ground conditions.	T	F
6	There are different methods of excavation.	T	F
7	Tunnels are not absolutely safe.	T	F

2. A TUNNEL BORING MACHINE (TBM)

1. Read the text and fill in the gaps with the following words.

• machines • disadvantage • process • transport (*v*)
• advantages • shorter • excavate
• expensive • reduces • diameters • longer

Tunnel boring machines (TBMs) and associated back-up systems can be used to automate the tunneling (*1*) ___________. A tunnel boring machine (TBM) also known as a “mole”, is a machine used to (*2*) ___________ tunnels with a circular cross section through a variety of soil and rock strata. They can bore through hard rock, sand, and almost anything in between. Tunnel (*3*) ___________ can range from a metre (done with micro-TBMs) to almost 16 metres to date.

Tunnel boring (*4*) ___________ are used as an alternative to drilling and blasting (D&B) methods in rock and conventional “hand mining” in soil. A TBM has the (*5*) ___________ of limiting the disturbance to the surrounding ground and producing a smooth tunnel wall. This significantly (*6*) ___________ the cost of lining the tunnel, and makes them suitable to use in heavily urbanized areas. The major (*7*) ___________ is the high cost. TBMs are (*8*) ___________ to construct, and can be difficult to (*9*) ___________. However, as modern tunnels become (*10*) ___________, the cost of tunnel boring machines versus D&B-method is actually less—this is because tunnelling with TBMs is much more efficient and results in a (*11*) ___________ project.

• was • operators • factors • types • used
• Project • difficult • diameter • operate
• Modern • pressure • manufactured

There are various TBMs that can (*12*) ___________ in a variety of conditions, from hard rock to soft water-bearing ground. Some (*13*) ___________ of TBMs have pressurized compartments at the front end, allowing them to be used in (*14*) ___________ conditions below the water table. This pressurizes the ground ahead of the TBM cutter head to balance the water pressure. The (*15*) ___________ work in normal air pressure behind the pressurized compartment, but may occasionally have to enter that compartment to renew or repair the cutters. This requires special precautions, such as local ground treatment or halting the TBM at a position free from water. Despite these difficulties, TBMs are now (*16*) ___________ more than the older method of tunneling in compressed air, with an air lock/decompression chamber some way back from the TBM, which required operators to work in high (*17*) ___________ and go through decompression procedures at the end of their shifts, much like divers.

Until recently the largest TBM built was used to bore the Green Heart Tunnel (*Dutch*: Tunnel Groene Hart) as part of the HSL-Zuid in the Netherlands. It had a (*18*) ___________ of 14.87 metres (48.8 ft). Nowadays even larger machines exist. All of these machines were built at least partly by Herrenknecht. Nowadays the largest diameter of TBM is 15.43 m. This TBM (*19*) ___________ built by Herrenknecht for a recent project in Shanghai, China. The machine was built to bore through soft ground including sand and clay. The largest diameter of TBM constructed for hard-rock excavation is 14.4 m. This TBM was (*20*) ___________ by The Robbins Company for Canada's Niagara Tunnel (*21*) ___________. The machine is currently boring a hydroelectric tunnel beneath Niagara Falls.

(*22*) ___________ TBMs typically consist of the rotating cutting wheel, called a cutter head, followed by a main bearing, a thrust system and trailing support mechanisms. The type of machine used depends on the particular geology of the project, the amount of ground water present and other (*23*) ___________.

2. Read the text again and answer the following questions.

1. What is the main purpose of usage of TBMs?
2. What are the methods of excavating a tunnel?
3. Why are TBMs used more often than other methods of tunneling?
4. How large are modern TBMs?
5. How many components do modern TBMs have?

3. DAMS

1. Read the text and fill in the gaps with the following words.

• prevent • organize • level • provide
• construction • dams • collect

A dam is a barrier that impounds (= takes water away) water or underground streams. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees (also known as dikes) are used to manage or (*1*) ___________ water flow into specific land regions. Hydropower and pumped-storage hydroelectricity are often used in conjunction with dams to (*2*) ___________ clean electricity for millions of consumers. It can also be used to (*3*) ___________ water or for storage of water which can be evenly distributed between locations.

Early dam building took place in Mesopotamia and the Middle East. Dams were used to control the water (*4*) ___________. Mesopotamia's weather affected the Tigris and Euphrates rivers and could be quite unpredictable.

One of the earliest (*5*) ___________ is situated in Jawa, Jordan, 100 km northeast of the capital Amman. This gravity dam featured a 9 m high and 1 m wide stone wall, supported by a 50 m wide earth rampart (= a high wide wall of stone with a path on top, built around a castle, town, etc.). The structure is dated to 3000 B.C. The Ancient Egyptian Sadd Al-Kafara at Wadi Al-Garawi, located about 25 kilometers south of Cairo, was 102 m long at its base and 87 m wide. The structure was built around 2800 or 2600 B.C. as a dam for flood control, but was destroyed by heavy rain during construction or shortly afterwards.

Roman dam construction was characterized by the Romans' ability to plan and (*6*) ___________ engineering construction on a grand scale. Roman planners introduced a new concept of large reservoir dams which could secure a permanent water supply for urban settlements (= towns) also over the dry season. They were pioneers in the process of (*7*) ___________ of much larger dam structures than previously built, such as the Lake Homs Dam, possibly the largest water barrier to date, and the Harbaqa Dam, both in Roman Syria. The highest Roman dam was the Subiaco Dam near Rome; its record height of 50 m remained unsurpassed until its accidental destruction in 1305.

• river • regulate • bridges • through
• cities • prevent • engineers

Roman (*8*) ___________ made routine use of ancient standard designs like embankment dams and masonry gravity dams. Apart from that, they displayed a high degree of inventiveness, introducing most of the other basic dam designs which had been unknown until then. These include arch-gravity dams, arch dams, buttress dams, and multiple arch buttress dams, all of which were known and employed by the 2nd century A.D. Roman workforces also were the first to built dam (*9*) ___________, such as the Bridge of Valerian in Iran.

The word "dam" can be traced back to Middle English, and before that, from Middle Dutch, as seen in the names of many old (*10*) ___________. For example, in the Netherlands, a low-lying country, dams were often applied to block rivers in order to (*11*) ___________ the water level and to (*12*) ___________ the sea from entering the marsh lands. Such dams often marked the beginning of a town or city because it was easy to cross the river at such a place. This often gave rise to the name of a city or a town. For instance the Dutch capital Amsterdam (old name Amstelredam) started with a dam (*13*) ___________ the river Amstel in the late 12th century, and Rotterdam started with a dam through the (*14*) ___________ Rotte, a minor tributary of the Nieuwe Maas. The central square of Amsterdam, covering the original place of the 800-year-old dam, still carries the name *Dam Square* or simply *the Dam*.

Types of dams

• power • tallest • building • function
• classified • city • walls

Dams can be formed by human agency, natural causes, or even by the intervention of wildlife such as beavers. Man-made dams are typically (*15*) ___________ according to their size (height), intended purpose or structure.

1) International standards define large dams as higher than 15–20 meters and major dams as over 150–250 meters in height. The (*16*) ___________ dam in the world is the 300-meter-high Nurek Dam in Tajikistan.

2) Purposes include providing water for irrigation to a town or (*17*) ___________ water supply; improving navigation; creating a reservoir of water to supply industrial uses; generating hydroelectric (*18*) ___________; creating recreation areas or habitat for fish and wildlife; retaining wet season flow to minimize downstream flood risk. Some dams can also serve as pedestrian (= a person who is walking in the street) bridges or bridges for vehicles across the river as well. Few dams serve all of these purposes but some multi-purpose dams serve more than one.

A saddle dam is an auxiliary dam constructed to confine the reservoir created by a primary dam either to permit a higher water elevation and storage or to limit the extent of a reservoir for increased efficiency. An auxiliary dam is constructed in a low spot or saddle through which the reservoir would otherwise escape.

An overflow dam is designed to be over topped.

A check dam is a small dam designed to reduce flow velocity and control soil erosion.

A wing dam is a structure that only partly restricts a waterway, creating a faster channel that resists the accumulation of sediment.

A dry dam is a dam designed to control flooding. It normally holds back no water and allows the channel to flow freely, except during periods of intense flow that would otherwise cause flooding downstream.

A diversionary dam is a structure designed to divert all or a portion of the flow of a river from its natural course.

3) Based on structure and material used, dams are classified as timber dams, arch-gravity dams, embankment dams or masonry dams, with several subtypes.

One of the best places for (*19*) ___________ a dam is a narrow part of a deep river valley; the valley sides can then act as natural (*20*) ___________. The primary (*21*) ___________ of the dam's structure is to fill the gap in the natural reservoir line left by the stream channel. The sites are usually those where the gap becomes a minimum for the required storage capacity. The most economical arrangement is often a composite structure such as a masonry dam flanked by earth embankments. The current use of the land to be flooded should be dispensable.

2. Read the text again and answer the following questions.

1. What is the main purpose of a dam?
2. What measurements did the earliest dam have?
3. How far from the capital of Egypt was the first ancient dam constructed?
4. Why are the Romans considered to be the pioneers in the process of dam-construction?
5. What is the connection between the word "dam" and the name of some cities in Europe?
6. What is the main principle of classification of dams?
7. Where do people usually construct dams?

4. CANALS

3. Read the following text. Try to understand it. Use your dictionary if necessary. Make up 8–10 questions to the text. Let your groupmates answer your questions. Check the answers.

Canals are human-made channels for water. There are two types of canals:

— aqueduct canals that are used for the delivery of fresh water, for human consumption, agriculture;
— waterway canals that are navigable transportation canals used for carrying ships and boats loaded with goods and people, often connected to existing lakes, rivers, or oceans. Included here are inter-ocean canals such as the Suez Canal and the Panama Canal.

The word “canal” is also used for a city-canal in cities such as Venice, Amsterdam, or Bangkok.

Smaller transportation canals can carry narrow-boats, while ship canals allow seagoing ships to travel to an inland port (e.g. Manchester Ship Canal), or from one sea or ocean to another (e.g. Caledonian Canal, Panama Canal).

At their simplest, canals consist of a trench (= a long narrow hole that is dug in the ground for water to flow along) filled with water. Depending on the stratum the canal passes through, it may be necessary to line the cut with some form of watertight material such as clay or concrete.

Canals need to be leveled. Different methods of solving this problem exist nowadays.

The oldest known canals were irrigation canals, built in Mesopotamia circa 4000 BC, in what is now modern day Iraq and Syria.

In ancient China, large canals for river transport were established as far back as the Warring States (481–221 BC), the longest one of that period being the Hong Gou (Canal of the Wild Geese), which according to the ancient historian Sima Qian connected the old states of Song, Zhang, Chen, Cai, Cao, and Wei. By far the longest canal was the Grand Canal of China, still the longest canal in the world today. It is 1,794 kilometres (1,115 mi) long and was built to carry the Emperor Yang Guang between Beijing and Hangzhou. The project began in 605 and was completed in 609.

In the Middle Ages, water transport was cheaper and faster than transport overland. This was because roads were unpaved and in poor condition; so greater amounts could be transported by ship. The first artificial canal in Christian Europe was the Fossa Carolina built at the end of the 8th century. More lasting and of more economic impact were canals like the Naviglio Grande built between 1127 and 1257.

Canal building progressed steadily in Germany in the 17th and 18th centuries with three great rivers, the Elbe, Oder and Weser being linked by canals. In post-Roman Britain, the first canal built appears to have been the Exeter Canal, which opened in 1563. The oldest canal built for industrial purposes in North America is Mother Brook in Dedham, MA. It was constructed in 1639 to provide water power for mills. In Russia, the Volga-Baltic Waterway, a nationwide canal system connecting the Baltic and Caspian seas via the Neva and Volga rivers, was opened in 1718.

Modern uses

Large-scale ship canals such as the Panama Canal and Suez Canal continue to operate for cargo transportation; as do European barge canals. Due to globalization, they are becoming increasingly important, resulting in expansion projects such as the Panama Canal expansion project.

A movement that began in Britain and France to use the early industrial canals for pleasure boats, such as hotel barges, has began very popular. In some cases abandoned canals such as the Kennet and Avon Canal have been restored and are now used by pleasure boaters. In Britain canal-side housing has also become popular in recent years.

The Seine-Nord Europe Canal is being developed into a major transportation waterway, linking France with Belgium, Germany, and the Netherlands.

Canals have found another use in the 21st century, as ducts for fibre optic telecommunications networks.

Canals are still used to provide water for agriculture. An extensive canal system exists within the Imperial Valley in the Southern California desert to provide irrigation to agriculture within the area.

Cities on water

Canals are so deeply identified with Venice that many canal cities have been nicknamed “the Venice of…”. The city is built on marshy islands, with wooden piles supporting the buildings, so that the land is man-made rather than the waterways. The islands have a long history of settlement; by the 12th century, Venice was a powerful city state.

Amsterdam was built in a similar way, with buildings on wooden piles. It became a city around 1300.

Other cities with extensive canal networks include Delft, Haarlem, and Leiden in the Netherlands, Brugge in Flanders, Birmingham in England, Saint Petersburg in Russia, Hamburg in Germany, Fort Lauderdale, Florida, and Cape Coral, Florida in the United States.

Inland canals have often had boats specifically built for them. An example of this is the British narrow-boat, which is up to 72 feet (21.95 m) long and 7 feet (2.13 m) wide and was primarily built for British Midland canals. Some canals has a limitation to boats of under 10 tons. Most canals have a limit on height because of bridges or tunnels.

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_12/)

1. THE CHANNEL TUNNEL (1)
(01:12)

Pre-listening

1. *What is a tunnel?*
2. *Why do people build tunnels?*
3. *What special equipment is used to build tunnels?*

While-listening

Watch the video and answer the following questions.

4. *What does the Channel Tunnel connect?*
5. *When did the project start?*
6. *How long did the construction last?*
7. *How much does the project cost?*
8. *How many workers were employed for the project?*
9. *When was the Tunnel opened?*
10. *What is its length?*
11. *How long is the journey through the Tunnel by car?*

Post-listening

12. *Make the summary of the video track.*
13. *Find information about any other tunnel to answer the same questions.*

2. THE CHANNEL TUNNEL (2)
(04:41)

Pre-listening

1. *What information do you remember about the Channel Tunnel?*

While-listening

Watch the video, read the inscriptions, and find the answers to the following questions.

2. *Which places (towns) in Britain and France exactly does the Tunnel connect?*
3. *Which tunnel is the longest in the world?*
4. *When did the idea of the construction appear first?*
5. *What was Albert Mathieu's plan?*
6. *What organizations were involved into the construction?*
7. *What capacity do the terminals have?*
8. *What should be taken into account by engineers before starting a construction of a tunnel under a channel?*

Post-listening

9. *Find information about any other tunnel and make a report to the class about it.*

3. TBM
(00:39)

Pre-listening

1. *What does the abbreviation "TBM" stand for?*
2. *What is TBM?*
3. *Who can operate TBM?*

While-listening

Watch the video and answer the following questions.

4. *How long is the TBM shown in the track?*
5. *Which two things (objects) is this TBM compared to?*
6. *How big is TBM shown in the track?*
7. *How heavy is it?*
8. *What does this TBM do?*

Post-listening

9. *Watch the video **without audio** and make your own comments.*

4. TUNNEL BORING MACHINE (04:00)

Pre-listening

1. *What is the main purpose of TBM?*
2. *Do you know the following words? Study the meaning of the words.*

   To press, to rotate, pressure, to chip, conveyer belt, protective roof, arch, football pitch.

While-listening

3. *Watch the video and put the following facts in the order of appearance in the track.*

A broken rock falls into a bucket wheel.	
The automotive device presses the rock.	
Vertical and horizontal position of a cutting head is constantly controlled.	
While boring goes on, work on construction of a protective roof is carried on.	
A complete ring of arch segments is transported to its final position.	
The cutting head rotates under a pressure of 27 tons.	
This TBM was specially developed for the hard rock.	
A broken rock is transferred onto a conveyer belt behind the cutting head.	
Steel arch segments are put under the protective roof.	
Each cutter chips the rock away.	

Watch the track again and answer the following questions.

4. *How many cutters does the cutting head have?*
5. *What distance can TBM drive a day?*
6. *What is TBM compared to?*
7. *How long is the TBM shown in the track?*
8. *What is the length of the TBM compared to?*

Post-listening

9. *Summarize everything you know about TBMs.*

5. A DAM—THE WONDER OF THE WORLD (01:13)

Pre-listening

1. *What is a dam?*
2. *What is the common use of a dam?*
3. *Do you think that dams are interesting for tourists to visit? Why?*
4. *Study the meaning of the word "sundial".*

   "Sundial" = a device used outdoors, especially in the past, for telling the time when the sun is shining.

   Do you believe that a dam can be a sundial?

While-listening

Watch the video and answer the following questions.

5. *What country is this dam situated in?*
6. *Why is the dam considered to be an interesting place to visit?*
7. *How is the time shown?*
8. *Which colour is used for a.m. hours; which is for p.m. hours?*
9. *What time range can be seen on the dam?*
10. *What is the aim of this ambitious project?*

Post-listening

11. *Make up your own comments on what you have just seen. Would you like to visit the place? Why?*

6. UC DAVIS NEWSWATCH. DAMS (01:54)

Pre-listening

1. *What is a dam?*
2. *What is the common use of a dam?*

While-listening

Watch the video and answer the following questions.

3. *Where is the dam situated?*

4. *What does this dam provide?*
5. *Who is the speaker and what does he do?*
6. *Is he for or against new dams? Why?*

Post-listening

7. *Which of the above-mentioned aims of a dam is the most important one? Why?*

7. CHINA'S YANGTZE DAM (03:03)

Pre-listening

1. *Where do people construct dams?*
2. *What for is this usually done?*
3. *What is the common use of a dam?*
4. *What problems may a construction of a dam provide?*
5. *Do you know the following words? Study the meaning of the words.*

   Displacement, debate, income.

While-listening

Watch the video and answer the following questions.

00:00—00:33

6. *Where is this picturesque place situated?*
7. *What kind of construction is shown in the track?*
8. *How far are these two places from each other?*
9. *What is the problem of the construction?*

00:34—00:51

10. *Why is the Chinese family shown in the track?*
11. *How big is the family?*
12. *How big is their place of living at the moment?*

00:52—01:00

13. *What does Ma Guoming think about the project?*

01:01—01:26

14. *How many dams are going to be built along the river?*

01:27—01:57

15. *Is compensation given quickly to the people?*
16. *How much is the compensation given?*
17. *How many residents were moved from their places of living?*

02:11—02:27

18. *Complete the following phrase: "No land means no ... and that ... an uncertain..."*

Post-listening

19. *Comment on the problem discussed in the track.*

8. ___________ CANAL MIRAFLORES (01:20)

Pre-listening

1. *What is a canal?*
2. *What famous canals do you remember?*
3. *Do you know the following words? Study the meaning of the following words.*

    Marvel = something that is wonderful or that surprises you; lock = a part of a canal where the level of water changes. Locks have gates at each end and are used to allow boats to move to a higher or lower level;
    to appreciate = to enjoy something or to understand the value of something.

While-listening

Watch the video and answer the following questions.

4. *What is the name of the Canal? Complete the heading.*
5. *What part of the world is the Canal situated in?*
6. *How long is the Canal?*
7. *What oceans are mentioned in the track? Why?*
8. *What is the height that the ships are raised?*
9. *Where exactly is the Miraflores Lock situated?*
10. *What is special about this Lock?*
11. *Who was this film made by?*

Post-listening

12. *Would you like to appreciate the process of ship passing through the lock?*

9. THE HISTORY OF PANAMA CANAL (1) (03:55)

THE HISTORY OF PANAMA CANAL (2) (08:17)

Pre-listening

1. *Try to remember everything you know about the Panama Canal.*

While-listening

2. *Watch the two videos. Try to understand any other facts about the Canal.*

Post-listening

3. *Summarize everything you know about the Canal and make a report to the class.*

13. SCIENTIFIC INVENTIONS

Part I

1. **What types of energy do you know?**
2. **What is used to:**
   — provide light;
   — power an old-fashioned clock;
   — heat buildings;
   — drive a car;
   — power a modern watch;
   — recharge batteries;
   — ride a bicycle.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 16*, *pg. 18*, *Ex. 1.*)

3. **Read the following text quickly and choose the correct answers to the questions below.**
   1. Trevor Baylis is
      (a) a doctor.
      (b) a TV presenter.
      (c) an inventor.
   2. The text is about
      (a) radios.
      (b) a clever idea.
      (c) Africa.

   In 1991, Trevor Baylis saw a television programme about people in Africa with AIDS. A doctor in the programme said he wanted to give everyone in his country information about the illness but very few people had televisions or radios. The problem was that radios were very expensive because the batteries cost more than a week's food for a family.

Trevor Baylis had a clever idea: a **clockwork** radio that didn't need batteries. He designed and developed a mechanism where the energy stored in a wound-up spring could be used to drive a **generator** to power the radio. He also added a panel to convert **solar energy** into electrical energy.

Trevor Baylis' **environmentally-friendly** radio has won lots of awards. The technology can be used in anything that needs batteries and it is perfect for countries where electrical power is **unreliable** or very expensive. The wind-up technology is now used in the new generation of Apple e-Mate computers.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 16*, *pg. 18*, *Ex. 3.*)

4. Find in the text the English equivalents to the following expressions.

Проблема заключалась в том, что; стоили дороже, чем; еженедельный рацион одной семьи; интересная идея; радио, основанное на принципе работы часового механизма; разработал и претворил в жизнь; привести в действие; превращать энергию; не причиняющее вред окружающей среде; может быть использовано; это идеально для; новое поколение компьютеров.

5. Read the text again and decide if the sentences below are true (T) or false (F).

1	Trevor Baylis had his idea when he watched a TV programme.	T	F
2	He wanted to give people information about AIDS.	T	F
3	His radio is powered in two different ways.	T	F
4	The idea has been successful.	T	F
5	Only radios can have clockwork power.	T	F

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 16*, *pg. 18*, *Ex. 4.*)

6. Complete the definitions below with the words in bold type in the text. Use the glossary or your dictionary to help you.

1. "...-..." means good for the health of people and the world.
2. ...is power produced by a wound-up spring.
3. Something that often doesn't work or breaks down is ... .
4. A ... converts mechanical power to electrical energy.
5. Power from the sun is ... .

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 16*, *pg. 18*, *Ex. 5.*)

7. Answer the questions to the text.

1. What was the clever idea that Trevor Baylis had?
2. When did this clever idea come to Trevor Baylis mind?
3. What was the reason for this clever idea?
4. Why did only few people in Africa have televisions or radios?
5. What was the principle of a new mechanism?
6. Where can Trevor Baylis's invention be used?
7. What do we call the kind of technology that Trevor Baylis invented?
8. What is the modern usage of this technology?

8. Match the following words.

• inventor • energy (×4) • electricity
• -friendly • information • technology
• invention • generation • a generator
• heating (×2) • power (×2)
• a mechanism • of computers

1	to generate		10	to collect	
2	to convert		11	gas	
3	to drive		12	young	
4	central		13	solar	
5	interesting		14	to design	
6	famous		15	environ-mentally	
7	to produce		16	the wind-up	
8	to store		17	generation	
9	electrical		18	type of	

9. Match the following words with their definitions below:

• inventor • heating • to convert • perfect • power
• energy • to invent • reliable • invention
• to store • to heat • generator • generation

1	The ability to be very active or do a lot of work without getting tired.	
2	Energy that can be collected and used for operating machines.	
3	To make something warm or hot.	
4	To think of something or make something for the first time.	
5	To keep something for future use.	
6	A system for making rooms and buildings warm.	
7	A machine that produces electricity.	
8	A person who has invented something.	
9	To change something from one form to another.	
10	Something that you can trust or rely on.	
11	All people who were born at about the same time	
12	Something that has been made or designed by somebody for the first time.	
13	It means "the best for" something.	

10. Fill in the gaps in the following sentences with suitable words from this module.

1. Toyota is a very ... car.
2. We need a ... to convert mechanical power into electrical energy.
3. New ... of cables appeared about 10 years ago.
4. Radio was a great ... of the 19th century.
5. Electrical, solar, kinetic—are different types of ... .
6. A lot of pieces of safety equipment were ... to protect the person's body.
7. These cables are very safe and quite ... .
8. Japan engineers have just designed a new ... of cars.
9. I can't find this information. Where do you ... it on your computer?

10. New generation of implants is rather ... and can be used safely.
11. The system of central ... is rather bad. It is usually chilly in the rooms.
12. How many ... of engineering do you know?

11. Translate the following sentences from English into Russian. Translate the idea, not word for word.

1. Children are usually full of energy.
2. What types of energy do you know?
3. What type of energy heats our houses?
4. Generator produces energy.
5. What powers the motor in this machine?
6. This is a high-powered engine.
7. How much is central heating nowadays?
8. What type of energy was used to heat buildings a century ago?
9. When was camera invented?
10. Is it your invention?
11. Who is the inventor of the wind-up technology?
12. Implant is a very useful invention.
13. Before the invention of printing people had written books by hand.
14. People usually store information on their computers.
15. Energy can be stored and then used.
16. Storing energy was a very clever invention.
17. Solar energy is converted into electricity.
18. It's cheaper to convert solar energy into electricity to heat buildings.
19. Japanese cars are usually very reliable.
20. Electrical power is unreliable in some countries.
21. People should care about the planet for future generations.
22. A new generation of implants has just been invented.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. A WIND-UP RADIO

Read the text and fill in the gaps with the following words.

• operation • clockwork • spring • countries
• powered • useful • equipment • electrical
• electricity • mechanisms

A (*1*) ___________ radio (or wind-up radio) is a radio that is (*2*) ___________ by human muscle power rather than batteries or the electrical grid. In the most common arrangement, an internal (*3*) ___________ generator is run by a mainspring, which is wound by a hand crank on the case. Turning the crank winds the (*4*) ___________, and a full winding will allow several hours of (*5*) ___________. Clockwork (*6*) ___________ have now been replaced by batteries charged by hand-crank generators in commercial crank-powered radios.

Like other self-powered (*7*) ___________, clockwork radios were intended for camping, emergencies, and for use in areas of the world where there is no (*8*) ___________ and replacement batteries are hard to obtain, such as in developing (*9*) ___________ or remote settlements. They are also (*10*) ___________ where a radio is not used on a regular basis and batteries would deteriorate, such as at a vacation house or cabin.

• store • organizations • model • batteries
• inventor • plugs • designed

Newer crank-powered radios that do not use clockwork, but are designed for emergency use, often include flashlights, blinking emergency lights, and emergency sirens. They also may include multiple alternate power sources such as conventional or rechargeable (*11*) ___________, auto cigarette lighter (*12*) ___________, and solar cells.

Radios powered by hand-cranked generators are not new, but their market was previously seen as limited to emergency or military (*13*) ___________. The modern clockwork radio was (*14*) ___________ and patented in 1991 by British (*15*) ___________ Trevor Baylis as a response to the AIDS crisis. He envisioned it as a radio for use by poor people in developing countries without access to batteries. In 1996 he co-founded Baygen Power Industries (now Freeplay Energy PLC), which produced the first commercial (*16*) ___________. The key to its design was the use of a constant velocity spring to (*17*) ___________ the potential energy.

2. TREVOR BAYLIS—A FAMOUS INVENTOR

1. **Read the text quickly and match the following headings with parts of the text (A—G).**

• Fame • Sports achievements
• The main invention • Personal details
• Business activity • Early life • Inventions

2. **Read the text again and fill in the gaps. Use the following words.**

A. ______________________________

• energy • inventor • AIDS
• powered • operate • radio
• batteries • Africa • invented

Trevor Graham Baylis is an English (*1*) ___________. He is best known for inventing the wind-up (*2*) ___________. Instead of using (*3*) ___________ or external electrical source, the radio is (*4*) ___________ by the user winding a crank for several seconds. This stores (*5*) ___________ in a spring which then drives an electrical generator to (*6*) ___________ the radio receiver. He (*7*) ___________ it in response to the need to communicate information about (*8*) ___________ to the people of (*9*) ___________.

B. ______________________________

• instructor • School • born • college
• UK • company • mechanical • skills

Trevor Baylis was (*10*) ___________ on 13 May 1937 to Cecil Archibald Walter Baylis and Gladys Jane Brown in Kilburn, London. He grew up in Southall, Middlesex, and attended North Primary (*11*) ___________.

His first job was in a Soil Mechanics Laboratory in Southall where a day-release arrangement enabled him to study (*12*) __________ and structural engineering at a local technical (*13*) _________.

C. ______________________________

A keen swimmer, he swam for Great Britain at the age of 15. He narrowly failed to qualify for the 1956 Summer Olympics. When he was 20, he started his National Service as a physical training (*14*) _________ and swam for the Army and Imperial Services during this time. When he left the army, he took a job with Purley Pools, the (*15*) __________ which made the first free-standing swimming pools. Initially he worked in a sales role but later in research and development. His swimming (*16*) __________ enabled him to demonstrate the pools and drew the crowds at shows, and this led to forming his own aquatic display company as professional swimmer, stunt (*a stunt = a very difficult or dangerous thing that somebody does to entertain people*) performer and entertainer, performing high dives into a glass-sided tank. With money earned from performing as an underwater escape artiste in the Berlin Circus he set up Shotline Steel Swimming Pools, a company which supplies modular swimming pools to schools in the (*17*) __________.

D. ______________________________

• motor • people • invent • prototype
• original • mechanism • television • wind-up
• production • information • workshop

Baylis' work as a stunt man made him feel kinship with disabled people through friends whose injuries had ended their performing careers. In 1985, this involvement led him to (*18*) __________ and developed a range of products for disabled (*19*) __________ called Orange Aids.

In 1991, he saw a (*20*) __________ programme about the spread of AIDS in Africa and that a way to stop the spread of the disease would be by education and (*21*) __________ using radio broadcasts. Before the programme had finished, he had assembled the first (*22*) __________ of his most well-known inventions, the (*23*) __________ radio, in his (*24*) __________. The (*25*) __________ prototype included a small transistor radio, an electric (*26*) ___________ from a toy car, and the clockwork (*27*) ___________ from a music box. He patented the idea and then tried to put it into (*28*) ___________, but was met with rejection from everyone he approached.

• produce • investors • programme
• generation • Design • 1992 • solar

The turning point came when his prototype was featured on the BBC TV (*29*) ___________ Tomorrow's World in April 1994. With money from (*30*) ___________ he formed a company Freeplay and in 1996 the Freeplay radio was awarded the BBC Design Award for Best Product and Best (*31*) ___________. In the same year Baylis met Queen Elizabeth II and Nelson Mandela at a state banquet, and also travelled to Africa with the Dutch Television Service to (*32*) ___________ a documentary about his life. He was awarded the 1996 World Vision Award for Development Initiative that year. Baylis filed his first patent in (*33*) ___________. 1997 saw the production in South Africa of the new (*34*) ___________ Freeplay radio, a smaller lighter model designed for the Western consumer market with a running time of up to an hour on twenty seconds of winding. This radio has since been updated and now includes a (*35*) ___________ panel so that it runs in sunshine without winding.

E. ______________________________

• ideas • battery • interviews • provides • invent
• protect • inventors • based • company

Numerous tours, (*36*) ___________ and television appearances have followed, and Baylis has been awarded many honours including the OBE in 1997, and eleven honorary degrees from UK universities (1998 to 2005) including the degree of Doctor of the University from the Open University in 2001. In 1999 he received the coveted Pipe Smoker of the Year Award for his invention of the Freeplay radio from the British Pipesmokers' Council, which honours famous pipesmokers. He continued to (*37*) ___________, and in 2001 he completed a 100 mile walk across the Namib Desert demonstrating his "electric shoes" and raising money for the Mines Advisory Group. The "electric shoes" use piezoelectric contacts in the heels to charge a small (*38*) ___________ that can be used to operate a radio transceiver or cellular telephone.

F. ______________________________

Following his own experience of the difficulties faced by (*39*) ___________, Baylis set up the Trevor Baylis Foundation to "promote the activity of Invention by encouraging and supporting Inventors and Engineers". This led to the formation of the (*40*) ___________ Trevor Baylis Brands PLC. The company (*41*) ___________ inventors with professional partnership and help; enables them to develop new (*42*) ___________; tries to (*43*) ___________ them; helps them to find the rout to market. Their primary goal is to secure license agreements for inventors, but they also consider starting up new companies around good ideas. The company is (*44*) ___________ in Richmond, London.

G. ______________________________

Baylis has lived on Eel Pie Island for many years; he regularly attends jazz performances at the noted Eel Pie Island Hotel. He is single and is a smoker. Baylis was diagnosed with Crohn's disease in 1971; part of his small intestine has been surgically removed.

3. **Read the text again and put the following facts from Trevor Baylis' life in the order of appearance in the text.**

He felt sympathy for disabled people.	
He was physically fit when he was young.	
At first it was difficult to begin production of his wind-up radio.	
Businessmen helped him to put his invention into practice.	
He had got some basic technical skills.	
Now he is the owner of a company that helps other inventors.	
He worked with a European company.	
There has been another interesting invention in his life.	
He worked as a seller for some time.	
Nowadays solar energy is used to power the radio.	
He likes music.	
The original prototype of the invention included three elements.	
He entertained people in order to earn money.	
He doesn't have family.	

Part III

(режим доступа для просмотра видеороликов http://englishtech.ru/video/modul_13/)

1. ALL ABOUT ENERGY AND THE ENVIRONMENT (01:59)

Pre-listening

1. *What types of energy do you remember?*
2. *Do you think that nowadays technical progress produces negative influence on our environment? Why?*
3. *What should be done to save our environment? Make a list of your own.*

While-listening

Watch the video and answer the following questions.

4. *Find the English equivalents to the following expressions.*
   Солнечные батареи; энергосберегающие лампы; альтернативные источники энергии; строительная компания; мусор; сваливать мусор; загрязнять воздух; не имеет значения; энергия приливов; сохранение источников энергии; человечество; найти способ.
5. *What should be done to save our environment? Compare the list of things in the video track with your own one.*

Post-listening

6. *Make a summary of the video track.*

2. HOW SOLAR ENERGY PANELS WORK? (01:14)

Pre-listening

1. *What is "solar energy"?*
2. *What are solar panels used for?*

3. *Why are solar panels becoming so popular?*
4. *Do you know the following words?*

Cell, layer.

While-listening

Watch the video and answer the following questions.

5. *What is the sunlight made of?*
6. *What are these "packets of energy" called?*
7. *What does a solar panel consist of?*
8. *What material is used in solar panels?*
9. *How is an individual cell designed?*
10. *Why are those layers needed?*
11. *What helps electrons to move from a panel to a bulb?*
12. *What is the flow of electrons?*
13. *What are the examples of usage of solar panels shown in the track?*

Post-listening

14. *Think of some other ways of possible usage of solar panels.*

3. AN ECO-RADIO (00:44)

Pre-listening

1. *What does "eco" mean?*

While-listening

Watch the video and answer the following questions.

2. *What powers this unit?*
3. *What does this unit do?*

Post-listening

4. *Where can we use this unit? Would you like to have one?*

4. A WIND-UP RADIO (01:29)

Pre-listening

1. *What does "a wind-up radio" mean?*

While-listening

Watch the video and answer the following questions:

2. *What can power this radio?*
3. *What are the elements of this radio? Where are they situated?*

Post-listening

4. *Where can we use this radio? Would you like to have one?*

5. TREVOR BAYLIS ECO-MEDIA PLAYER (01:37)

Pre-listening

1. *Who is Trevor Baylis?*
2. *What is he famous for?*
3. *What does "eco" mean?*
4. *What does "media player" mean?*

While-listening

Watch the video and answer the following questions.

5. *How many years ago did Trevor Baylis invent the clockwork radio?*
6. *What country did he invent the radio for?*
7. *What kind of problem was there in Africa?*
8. *What is his original idea?*
9. *Complete the following phrase that Trevor says: "Welcome to the next..."*
10. *What are the parameters of work of the invented player?*

Post-listening

11. Summarize everything you know about this eco-media player. What are its characteristics?

6. TREVOR BAYLIS—AN INVENTOR (04:37)

Pre-listening

1. *What is Trevor Baylis famous for?*

2. *What country was his invention for?*
3. *What kind of problem was there in that country?*

While-listening

Watch the video and answer the following questions.

4. *Why did he start his own company?*
5. *What are the questions that he asks himself before producing assistance to inventors?*
6. *What is a "dragons' den"?*
7. *Does Trevor think that the art of invention can be taught?*

Post-listening

8. *What advice can be given to a person who wants to invent something?*

14. ROBOTS IN OUR LIFE

Part I

1. **How many senses have you got? What are they? Why are they important?**
2. **Match the verbs in column A with the parts of the body in column B and the sense nouns in column C.**

A *Verbs*	**B** *Parts of the body*	**C** *Sense nouns*
see	nose	smell
hear	hands	touch
smell	eyes	sight
taste	ears	hearing
touch	mouth	taste

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 17*, *pg. 19*, *Ex. 2.*)

3. **What is the difference between *see* and *look*, *hear* and *listen*?**

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 17*, *pg. 19*, *Ex. 3.*)

4. **Read the following text quickly and choose the correct answers to the questions below. Don't pay attention to the gaps.**
   1. Are the paragraphs about
      (a) lots of topics?
      (b) one topic?
   2. Which is the best title?
      (a) Imaginary robots in film and fiction.
      (b) Robots: the fantasy and the facts.

A. We can thank the world of literature for the words *robot* and *robotics*. The word *robot* was first used by the Czech playwright Karel

Čapek in his 1921 play, *R.U.R.* (Rossum's Universal Robots). (*1*) ________________. Asimov used it in a short story in 1941.

B. Robots often star in films too, for example dangerous machines like Terminator or cute ones like R2D2 in *Star Wars*. (*2*) ________________. Industrial robots don't have personalities and they don't think like people. Most real robots are designed to save people from dangerous jobs (*3*) ________________ or boring, routine work (*4*) ________________.

C. A simple robot is made of:
- a mechanical device (*5*) ________________ that can react to its environment;
- sensors that (*6*) ________________ give information to the device;
- systems or computer programs that (*7*) ________________ give the device instructions.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 17*, *pg. 19*, *Ex. 4.*)

5. Read the text again and put the sentences and phrases below in the correct places.

a	in factories, laboratories, or warehouses	
b	In this play machines behave like people.	
c	like an arm	
d	can "see" the environment and	
e	like handling nuclear or radioactive materials	
f	The reality is less exciting.	
g	understand the messages from the sensors and	

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 17*, *pg. 19*, *Ex. 5.*)

6. Find in the text the English equivalents to the following expressions (don't forget about phrases from Ex. 5).

Мы можем поблагодарить; мир литературы; ведут себя как люди; принимают участие в фильмах; опасные машины; роботы, используемые на производстве; разработаны с целью; оградить от; однообразная работа; обычный робот; сделан из; механическое устройство; реагировать на; сообщать информацию; давать инструкции.

7. Read the text again and find the words in the text that mean:

1. always done in the same way;
2. respond to a change;
3. a piece of equipment designed to do a particular job;
4. part of a machine that can sense heat, light, etc.;
5. very, very small;
6. type of robots used in manufactures;
7. everything around us;
8. a command to do something or explanation of how to do something.

(*No. 1–4 are taken from* "*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 17*, *pg. 19*, *Ex. 7.*)

8. What is the connection between human senses (feelings, emotions) and robots? What can (or can't) people and robots do? Use: *see, hear, smell, taste, touch, think, feel, cry, smile,* etc. and information from the text. Make up sentences. Use the example below:

Example: People can see. Robots can see.
People can ... .
Robots can't ... .

9. Answer the following questions to the text.

1. What country was the first to introduce the word "robot"?
2. How old is this word?
3. What is the main difference between a robot and a person?
4. What is the main purpose of a robot?
5. What is a simple robot made of?
6. What is the aim of each element of a simple robot?
7. What helps a robot "feel" the environment?
8. Who or what instructs the device?

For questions 9–11 you may use the expressions below or your own examples.

• show emotions • see • help people work in dangerous situations
• get information from the outside • save people's lives
• get instructions • react to the environment • hear
• design computer systems to operate robots • smell

• think like people • give instructions
• understand the messages from the sensors, etc.

9. What can (cannot) people and robots do?
10. What can (cannot) robots do?
11. What can (cannot) people do?
12. What are the advantages of a robot?
13. What are the disadvantages of a robot?
14. What can power a robot?

10. Match the following words.

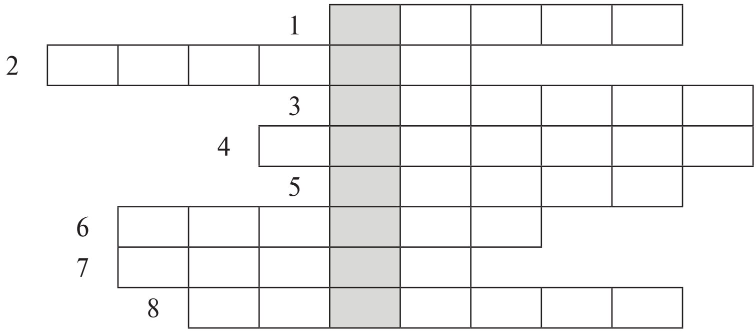
• information (×2) • people • robot (×2) • work • used
• jobs • in films • program • the message • material
• device • machines • like • people • sensors

1	was		9	mechanical	
2	star		10	give	
3	dangerous		11	computer	
4	industrial		12	behave	
5	save		13	radioactive	
6	dangerous		14	get	
7	routine		15	understand	
8	simple		16	message from	

11. Find the 5 senses in the box below. The words may be written horizontally, vertically or diagonally.

	a	b	c	d	e	f	g	h	i	j
1	A	N	G	I	L	K	X	O	P	S
2	S	S	M	E	L	L	M	A	F	M
3	N	S	R	K	R	U	K	G	G	E
4	P	O	D	Y	L	J	N	Z	X	L
5	N	D	A	S	L	I	D	I	S	D
6	C	S	M	T	R	F	J	K	T	O
7	A	I	O	A	T	U	O	C	H	Z
8	N	G	E	S	W	E	Q	F	J	E
9	R	H	A	T	O	U	C	H	Q	H
10	H	T	B	E	A	W	S	L	M	I

12. Do the crossword. What is hidden on the vertical highlighted line?



1. To change after coming into contact with another substance.
2. A device that can react to light, heat, pressure, etc.
3. Not interesting at all, dull.
4. The usual order of things; when you do something regularly.
5. The ability to recognize the flavour of food or drink.
6. A tool or piece of equipment.
7. The ability to feel things by putting your hands or fingers on them.
8. You leave it for a person if he is not at home and you have some information for him.

13. Fill in the gaps in the following sentences with suitable words from the list below.

• instructions • information • react
• routine • dangerous • sensors
• save • devices • messages • handle

1. Terminator—is a kind of ... machines.
2. Different mechanical ... are widely used in industry.
3. Sensors usually give ... to the computer.
4. Computers understand information from ... .
5. Information is delivered to the computer with the help of coded ... .
6. Computer systems give ... to robots.
7. The aim of different devices is to ... people.
8. The process of doing one and the same thing is called "...".

9. Robots ... radioactive materials instead of people.
10. Robots can ... to the environment.

14. Translate the following sentences from English into Russian. Translate the idea, not word for word.

1. I've got a cold and I've lost my sense of smell.
2. Dogs have an acute sense of hearing.
3. Robots may have the same senses as people.
4. Nowadays robots help people to manufacture goods.
5. Robot is a very useful device.
6. A device like a robotic arm helps people to save their time and body.
7. Nowadays different electrical and mechanical devices are very important in our life.
8. What kind of device would you like to invent?
9. The sensor of sight is not working in this robot.
10. This robot should be repaired because its sensors are out of order.
11. This piece of equipment has sensor buttons.
12. This mobile has got a sensor type of screen.
13. If the Top Engineer is out, I'll leave a message for him.
14. The computer system understood the message and gave instructions to the robot immediately.
15. People and robots have a lot in common.
16. Robots can't feel and think like people.
17. Sensors should react quickly to the environment and send messages to a computer system.
18. A new generation of robots has just been designed by Japanese engineers.
19. Robotics is the usage of robots in manufacturing process.
20. Robots can handle radioactive materials.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. THE WORD “ROBOT” AND ITS ETYMOLOGY

Read the text and fill in the gaps with the following words.

• factory • machine • idea • types
• robot • industrial • introduce
• repetitive • letter • introduced

There is no one definition of robot which satisfies everyone. So, many people have their own definitions. For example, Joseph Engelberger, a pioneer in (*1*) ___________ robotics, once remarked: “I can’t define a robot, but I know one when I see one.” According to the Encyclopedia Britannica, a robot is “any automatically operated (*2*) ___________ that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner”. Merriam-Webster describes a (*3*) ___________ as a “machine that looks like a human being and performs various complex acts (as walking or talking) of a human being”, or a “device that automatically performs complicated and often (*4*) __________ tasks”, or a “mechanism guided by automatic controls”.

The word *robot* was introduced to the public by Czech writer Karel Čapek in his play *R.U.R.* (Rossum’s Universal Robots), published in 1920. The play begins in a (*5*) ___________ that makes artificial people called *robots*. They can plainly think for themselves, though they seem happy to serve. The main (*6*) ___________ of the play is whether the robots are being exploited and the consequences of their treatment.

However, Karel Čapek himself did not (*7*) ___________ the word. He wrote a short (*8*) ___________ in reference to an etymology in the *Oxford English Dictionary* in which he named his brother, the painter and writer Josef Čapek, as its actual originator. In an article in the Czech journal *Lidové noviny* in 1933, he explained that he had originally wanted to call the creatures *laboři* (“workers”, from Latin *labor*). However, he did not like the word, and sought advice from his brother Josef, who suggested “roboti”. The word *robota* means literally “work”, “labour” or “serf labour”, and figuratively “drudgery” or “hard work” in Czech and many Slavic languages. Traditionally the *robota* was the work period a serf (corvee) had to give for his lord, typically six months of the year. Serfdom was outlawed in 1848 in Bohemia, so at the time Čapek wrote *R.U.R.*, usage of the term *robota* had broadened to include various (*9*) ___________ of work.

The word *robotics*, used to describe the study of robots, was (*10*) ___________ by the science fiction writer Isaac Asimov.

2. A ROBOT IN A MODERN WORLD

Read the text and fill in the gaps with the following words.

• manufacturing • century • manipulate • industrial
• earth • machine • dangerous • create

A robot is an automatically guided (*1*) ___________ which is able to do tasks on its own.

The word *robot* can refer to both physical robots and virtual software agents, but the latter are usually referred to as bots. There is no consensus on which machines qualify as robots, but there is general agreement among experts and the public that robots tend to do some or all of the following: move around, operate a mechanical limb, sense and (*2*) ___________ their environment, and exhibit intelligent behavior, especially behavior which mimics humans or other animals.

Stories of artificial helpers and companions and attempts to (*3*) ___________ them have a long history but fully autonomous machines only appeared in the 20th (*4*) ___________. The first digitally operated and programmable robot, the Unimate, was installed in 1961 to lift hot pieces of metal from a die casting machine and stack them. Today, commercial and (*5*) ___________ robots are in widespread use performing jobs more cheaply or with greater accuracy and reliability than humans. They are also employed for jobs which are too dirty, (*6*) ___________ or dull to be suitable for humans. Robots are widely used in (*7*) ___________, assembly and packing, transport, (*8*) ___________ and space exploration, surgery, weaponry, laboratory research, and mass production of consumer and industrial goods.

• electric • assembly • countries • definition
• controlled • objects • technological • react

Nowadays it is difficult to compare numbers of robots in different (*9*) ___________, since there are different definitions of what a "robot" is. The International Organization for Standardization gives a (*10*) ___________ of robot in ISO 8373: "an automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications". This definition is used by the International Federation of Robotics, the European Robotics Research Network (EURON), and many national standards committees.

Modern robots are usually used in tightly controlled environments such as on (*11*) ___________ lines because they have difficulty responding to unexpected interference. Because of this, most humans rarely encounter robots. However, domestic robots for cleaning and maintenance are increasingly common in and around homes in developed countries, particularly in Japan. Japan hopes to have full-scale commercialization of service robots by 2025. Much (*12*) ___________ research in Japan is led by Japanese government agencies, particularly the Trade Ministry.

While there is no single correct definition of "robot", a typical robot will have several, or possibly all, of the following characteristics: it is an (*13*) ___________ machine which has some ability to interact with physical (*14*) ___________ and to be given electronic programming to do a specific task or to do a whole range of tasks or actions. It may also have some ability to perceive and absorb data on physical objects, or on its local physical environment, or to process data, or to (*15*) ___________ to the changes of its environment. This is in contrast to a simple mechanical device such as a gear or a hydraulic press or any other item which has no processing ability and which does tasks through purely mechanical processes and motion.

For robotic engineers, the physical appearance of a machine is less important than the way its actions are (*16*) ___________. The more the control system seems to have agency of its own, the more likely the machine is to be called a robot.

3. TYPES OF ROBOTS

Read the text and fill in the gaps with the following words.

• tasks • classified • perform • types • designed
• welding • sensors • objects • environment

At present there are two main (*1*) ___________ of robots, based on their use: general-purpose autonomous robots and dedicated robots.

General-purpose autonomous robots are robots that can (*2*) ___________ a variety of functions independently. General-purpose autonomous robots typically can navigate independently in known spaces, handle their own re-charging needs, interface with electronic doors and elevators, and perform other basic tasks. Like computers, general-purpose robots can link with networks, software, and accessories that increase their usefulness. They may recognize people or (*3*) ___________, talk, provide companionship, monitor environmental quality with the help of (*4*) ___________, react to the changes in its (*5*) ___________, pick up supplies and perform other useful tasks. General-purpose robots may perform a variety of functions simultaneously or they may take on different roles at different times of day. Some such robots try to mimic human beings and may even resemble people in appearance; this type of robot is called a humanoid robot.

Robots can be (*6*) ___________ by their specificity of purpose. A robot might be (*7*) ___________ to perform one particular task extremely well, or a range of (*8*) ___________ less well. Of course, all robots by their nature can be re-programmed to behave differently, but some are limited by their physical form. For example, a factory robot arm can perform jobs such as cutting, (*9*) ___________, gluing, or acting as a fairground ride, while a pick-and-place robot can only populate printed circuit boards.

4. THE USAGE OF ROBOTS

Match the headings below with the gaps in the following text.

• Telerobots • Car production • Home automation
• Space probes • Automated guided vehicles

• Home automation for the elderly and disabled
• Packaging • Dirty, dangerous, dull, or inaccessible tasks
• Robotic surgery • A robotic arm • Electronics

Nowadays the number of spheres where different types of robots are used is constantly increasing. The usage of different types of robots is as follows:

(*1*) ___________. Over the last three decades automobile factories have become dominated by robots. A typical factory contains hundreds of industrial robots working on fully automated production lines, with one robot for every ten human workers. On an automated production line, a vehicle chassis on a conveyor is welded, glued, painted, and finally assembled at a sequence of robot stations.

(*2*) ___________. Industrial robots are also used extensively for palletizing and packaging of manufactured goods, for example for rapidly taking drink cartons from the end of a conveyor belt and placing them into boxes, or for loading and unloading machining centers.

(*3*) ___________. Mass-produced printed circuit boards (PCBs) are almost exclusively manufactured by pick-and-place robots, typically with SCARA manipulators, which remove tiny electronic components from strips or trays, and place them on to PCBs with great accuracy. Such robots can place hundreds of thousands of components per hour, far out-performing a human in speed, accuracy, and reliability.

(*4*) ___________ (AGVs). Mobile robots, following markers or wires in the floor, or using vision or lasers, are used to transport goods around large facilities, such as warehouses, container ports, or hospitals.

(*5*) ___________. There are many jobs which humans would rather leave to robots. The job may be boring, such as domestic cleaning, or dangerous, such as exploring inside a volcano. Other jobs are physically inaccessible, such as exploring another planet, cleaning the inside of a long pipe, or performing laparoscopic surgery.

(*6*) ___________. Almost every unmanned space probe ever launched was a robot. Some were launched in the 1960s with more limited abilities, but their ability to fly and to land (in the case of Luna 9) is an indication of their status as a robot. This includes the Voyager probes and the Galileo probes, as well as other probes.

(*7*) ___________. When a human cannot be present on site to perform a job because it is dangerous, far away, or inaccessible, teleoperated robots, or telerobots are used. Rather than following a predetermined sequence of movements, a telerobot is controlled from a distance by a human operator. The robot may be in another room or another country, or may be on a very different scale to the operator. For instance, a laparoscopic surgery robot allows the surgeon to work inside a human patient on a relatively small scale compared to open surgery, significantly shortening recovery time. When disabling a bomb, the operator sends a small robot to disable it. Teleoperated robot aircraft, like the Predator Unmanned Aerial Vehicle, are increasingly being used by the military. These pilotless drones can search terrain and fire on targets.

(*8*) ___________. As prices fall and robots become smarter and more autonomous, simple robots dedicated to a single task work in over a million homes. They are taking on simple but unwanted jobs, such as vacuum cleaning and floor washing, and lawn mowing. Some find these robots to be cute and entertaining, which is one reason that they can sell very well.

(*9*) ___________. The population is aging in many countries, especially Japan, meaning that there are increasing numbers of elderly people to care for, but relatively fewer young people to care for them. Humans perform the best care, but where they are unavailable, robots are gradually being introduced. For example, the care-providing robot FRIEND is a semi-autonomous robot designed to support disabled and elderly people in their daily life activities, like preparing and serving a meal, or reintegration in professional life. FRIEND makes it possible for such people, e.g. patients which are paraplegic, have muscle diseases or serious paralysis, e.g. due to strokes, to perform special tasks in daily life self-determined and without help from other people like therapists or nursing staff. The robot FRIEND is the third generation of such robots developed at the Institute of Automation (IAT) of University of Bremen within different research projects.

(*10*) ___________. It is the use of robots in performing surgery. Three major advances aided by surgical robots have been remote surgery, minimally invasive surgery and unmanned surgery. Some major advantages of robotic surgery are precision, miniaturization, smaller incisions, decreased blood loss, less pain, and quicker healing time. Further advantages are articulation beyond normal manipulation and 3D (three-dimensional) magnification, resulting in improved ergonomics.

(*11*) ___________. It is a robot manipulator, usually programmable, with similar functions to a human arm. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The business end of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand. The end effector can be designed to perform any desired task such as welding, gripping, spinning, etc., depending on the application. For example, robot arms in automotive assembly lines perform a variety of tasks such as welding and parts rotation and placement during assembly. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy. The robotic arm can be fixed or mobile (i.e. wheeled) and can be designed for industrial or home applications.

Robots can also be found in the military.

5. POTENTIAL PROBLEMS

Read the text and fill in the gaps with the following words.

• films • software • computers
• programmed • humans

Vernor Vinge has suggested that a moment may come when (*1*) ___________ and robots are smarter than humans. He calls this “the Singularity”. He suggests that it may be somewhat or possibly very dangerous for (*2*) ___________. This is discussed by a philosophy called Singularitarianism.

Fears and concerns about robots can be found in a wide range of books and (*3*) ___________. A common theme is the development of a master race of conscious and highly intelligent robots, motivated to take over or destroy the human race. (See *The Terminator*, *Runaway*, *Blade Runner*, *Robocop*, the Replicators in *Stargate*, the Cylons in *Battlestar Galactica*, *The Matrix*, *THX-1138*, and *I*, *Robot*.) Some fictional robots are (*4*) ___________ to kill and destroy; others gain superhuman intelligence and abilities by upgrading their own (*5*) ___________ and hardware. Examples of popular media where the robot becomes evil are *2001*: *A Space Odyssey*, *Red Planet*. ... Another common theme is the reaction, sometimes called the "uncanny valley", of unease and even revulsion at the sight of robots that mimic humans too closely. *Frankenstein* (1818), often called the first science-fiction novel, has become synonymous with the theme of a robot or monster advancing beyond its creator. In the TV show, Futurama, the robots are portrayed as humanoid figures that live alongside humans, not as robotic butlers. They still work in industry, but these robots carry out daily lives.

6. ROBOTICS

Read the text and fill in the gaps with the following words.

• mechanical • manufactures • designs • disciplines
• scientists • engineering • companies • planning
• production • control • consultant • students

Robotics is a new science connected with the design, (*1*) ___________, and software maintenance of robots. Nowadays robotics is paid great attention by the (*2*) ___________ all over the world. Many countries have companies handling the problems of robotics. And in some countries robotics has even been introduced into the lives of elementary and high school (*3*) ___________.

A person involved in the process of robotics development is called a roboticist. He (*4*) ___________, builds, programs, and experiments with robots. Since robotics is a highly interdisciplinary field, roboticists often have backgrounds in a number of (*5*) ___________ including computer science, (*6*) ___________ engineering, electrical (*7*) ___________, and computer engineering. Roboticists often work for university, industry, and government research labs, but may also work for startup companies and other firms.

Universal Robotics, Inc, is one of software engineering (*8*) __________ that develops, (*9*) __________, and supports an operating system for machine intelligence. Headquartered at Smith Springs in Nashville, Tennessee, Universal Robotics was co-founded by professor Dr. Alan Peters, of the Center for Intelligent Systems in the School of Engineering at Vanderbilt University and his brothers David Peters, a businessman, and Jonathan Peters, an IT (*10*) __________. The company was incorporated as a holding company on August 29, 2001. Universal is a hybrid of functional and product organizational structures. There are six task areas: 1) strategic (*11*) __________, 2) sales and service of customers, 3) engineering and programming, 4) quality (*12*) __________, 5) research and development, and 6) security.

7. A ROBOTIC SPACECRAFT

1. Read the text and fill in the gaps with the following words.

• animal • scientific • vehicles
• humans • risk

A robotic spacecraft is a spacecraft with no (*1*) __________ on board, that is usually under telerobotic control. A robotic spacecraft designed to make (*2*) __________ research measurements is often called a space probe. Many space missions are more suited to telerobotic rather than crewed operation, due to lower cost and lower (*3*) __________ factors. In addition, some planetary destinations such as Venus or the vicinity of Jupiter are too hostile for human survival, given current technology. Outer planets such as Saturn, Uranus, and Neptune are too distant to reach with current crewed spaceflight technology, so telerobotic probes are the only way to explore them.

The first space mission, Sputnik 1, was an artificial satellite put into Earth orbit by the USSR on 4 October 1957. On 3 November 1957, the USSR orbited Sputnik 2, the first to carry a living (*4*) __________ into space—a dog.

The USA achieved its first successful space probe launch with the orbit of Explorer 1 on 31 January 1958.

Only a few other countries have successfully launched orbital missions using their own (*5*) ___________: France (1965), Japan (1970), China (1970), the United Kingdom (1971), India (1981), Israel (1988).

2. Read the seven texts above again and decide if the following sentences are true (T) or false (F).

1	The word “robot” was introduced by Karel Čapek.	T	F
2	Before 1848 a serf had to work for his lord for half a year.	T	F
3	We can’t use the word “robot” when we speak about software programs.	T	F
4	Different countries have different definitions of a robot.	T	F
5	Japanese government is very interested in the development of technological research of robots.	T	F
6	The number of spheres where robots are used is rather small.	T	F
7	Robotic arm can be used in our own homes as well as in industry.	T	F
8	There is no danger for people in the process of robot development.	T	F
9	A roboticist is a person who needs inter-disciplinary knowledge.	T	F
10	Russia was the first to launch a robotic spacecraft.	T	F

Part III

(режим доступа для просмотра видеороликов http://englishtech.ru/video/modul_14/)

1. WHAT IS ROBOTIC ENGINEERING? (01:27)

Pre-listening

1. *What is a robot?*
2. *Why do people design robots?*
3. *What is a simple robot made of?*
4. *Study the following words.*

   Manipulator, to hide/hid/hidden, underneath, customer, mine.

While-listening

Watch the video track and answer the following questions.

5. *What do robotic engineers do?*
6. *What type of a robot is spoken about in the track?*
7. *What does such kind of robots consist of?*
8. *Where is the controller of this robot?*
9. *What functions must a robotic engineer perform?*
10. *What are possible applications of robots that are mentioned by the speaker?*
11. *How does the speaker characterize possible applications of robots? What adjective does he use?*

Post-listening

12. *What is robotic engineering? Use the answers to the questions above and make a small text about robotic engineering.*

2. INDUSTRIAL ROBOT (01:28)

Pre-listening

1. *What is “industrial robot”?*

2. *What tasks can an industrial robot perform?*
3. *Do you know the following words?*

   Dexterity = skill at doing things, especially with your hands; appliance = a piece of equipment for a particular purpose in the house.

While-listening

Watch the video track and answer the following questions.

4. *What are the main types of industrial robots that are mentioned in the text?*
5. *What are the advantages of using a robot instead of manual welding?*
6. *What can robotic welding provide?*
7. *What is the result of robotic welding?*
8. *Where are industrial robots mostly used?*

Post-listening

9. *Why are industrial robots becoming so popular in modern manufacturing? Use the answers to the questions above to answer this question.*

3. ROBOTIC TECHNOLOGY SYSTEMS (01:06)

Pre-listening

1. *What is a robot?*
2. *What is an "industrial robot"?*
3. *What is robotics?*
4. *What do robotic engineers do?*
5. *Do you know the following words?*

   Sophisticated, stock exchange.

While-listening

Watch the video track **part by part** and answer the following questions.

00:00—00:22

6. *What is RTS (robotic technology system)?*
7. *What does RTS specialize in?*

00:23—00:39

8. Fill in the gaps in the following passage with the words you hear.

...A recognized (*1*) ___________ in a chosen (*2*) ___________ RTS operates (*3*) ___________, supplying (*4*) ___________ and innovative (*5*) ___________ for life science drug discovery, food (*6*) ___________ applications, and (*7*) ___________ and support (*8*) ___________ in the nuclear industry...

00:40—end

9. What do engineers of this company help their clients to do?

10. What financial organization does rts cooperate with?

Post-listening

11. Do you know any other international organization of the kind? Get ready to speak about it.

4. ROBOTS WITH THE MIND OF THEIR OWN (01:35)

Pre-listening

1. What is a robot?

2. What is a simple robot made of?

3. How does a robot operate?

4. Do you know the following words? Study their meaning in your glossary or dictionary.

(To) swarm, artificial, alongside.

While-listening

Watch the video track **part by part** and answer the following questions.

00:00—00:20

5. Fill in the gaps in the following passage with the words you hear.

Until (*1*) ___________ it has been a stuff of (*2*) ___________ fiction—many (*3*) ___________ joining together, a bit like lego, to form one big (*4*) ___________ capable of performing tasks too (*5*) ___________ or (*6*) ___________ for (*7*) ___________. Hundreds of (*8*) ___________ from the UK are working alongside colleagues in (*9*) ___________ to make this vision a (*10*) ___________.

00:21—00:44

6. *What is in the box shown in the track?*
7. *What is the aim of this project?*
8. *Fill in the gaps in the following passage with the words you hear.*

What do we want to do in the next (*1*) ___________ years is to (*2*) ___________ robots so that they can (*3*) ___________ join and (*4*) ___________ a kind of (*5*) ___________-dimensional artificial (*6*) ___________.

00:45—end

9. *What are the ambitious aims of usage of this new technology?*
10. *Does the speaker think that we should be worried because of the fact that these robots are going to have mind of their own?*
11. *When, as it is said in the track, this project is going to be a reality?*

Post-listening

12. *Do you think that robots have their own mind? Why?*
13. *Do you think that people should be afraid of robots with their own mind in future? Why?*

15. GADGETS

Part I

1. Look at the pictures (1–4). Can you guess what the things on the pictures are? Answer the following questions.

— What are they made of?
— Which is the most expensive?
— Which is the cheapest?

4

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 18*, *pg. 20*, *Ex. 1.*)

2. Read the descriptions (A–D) and match them with the pictures (1–4).

A. *LETTER OPENER CLOCK* (£19.99)

Desktop clock, thermometer, calendar, and letter opener

This gadget has got lots of helpful information—with the added **benefit** of an automatic electric letter opener. The LCD display shows date, time, and temperature in °C or °F. In addition there is an alarm clock, a calculator, and the times in 15 cities around the world.

Letter opener uses 2 × AA batteries (not supplied). 5.5 × 12 × × 9.5 cm.

B. *RADIO PEN* (£14.99)

Sounds as good as it writes

This pen looks beautiful, feels great to write with—but it sounds better in the ears. It's got a **secret** radio in the top! Wear the earphones and enjoy music while you work.

Button batteries included. 14 cm long.

C. *FEET WASHER* (£19.99)

The best thing for your feet

Designed for shower or bath, this **vinyl** mat cleans and massages your feet—and you don't need to bend down or stand on one leg! **Suction** cups hold it safely while you stand on the 1,500 relaxing "fingers". 2.5 × 14.5 × 27.5 cm.

D. *BED GLASSES* (£29.99)

How to read or watch TV—flat on your back

These glasses are perfect for sick people who must stay in bed, or for people who like to relax with a book or watch TV while lying flat on the floor or sofa. The plastic frame contains two glass **prism**s that **deflect** your vision by 90°. The **lenses** are first-class and you can wear them over your normal glasses.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 18*, *pg. 20*, *Ex. 2.*)

3. Read the texts (A–D) again and match the sentences (1–6) below with the gadgets.

1	These two don't need batteries.	
2	This does two things.	
3	You use this standing up.	
4	You use these lying down.	
5	This can tell you how hot it is.	
6	You get free batteries with this.	

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 18*, *pg. 20*, *Ex. 3.*)

4. Read the text again and find the English equivalents to the following expressions.

Устройство (приспособление); полезная информация; преимущество; также (плюс к этому); по всему миру; не входят в комплект; нет необходимости; выглядит красиво; получать удовольствие; идеально подходят для; пластиковый каркас.

5. Read the text again and find synonyms to the following words and phrases.

Device; useful; advantage; monitor; not included; without any danger; be ideal for; people who are ill; of high quality; usual, ordinary.

6. Complete the definitions with the words in bold type in the text. Use the glossary or your dictionary to help you.

1. A ... is a good thing.
2. A ... is a triangular block of glass.
3. ... are the pieces of glass you look through.
4. ... holds/attaches with air pressure.
5. ... is a type of plastic.
6. ... means “hidden”.
7. To ... means “to change direction”.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 18*, *pg. 20*, *Ex. 4.*)

7. Complete the definitions with the words from the text.

• vision • gadget • frame
• to include • display • to supply
• to contain • vinyl

1	To provide someone with something.	
2	A border of wood or metal that goes around the outside of a door, picture, window, etc.	
3	To have something inside.	
4	A small device, tool, or machine that has a particular but usually unimportant purpose.	
5	To have as one part of something.	
6	Ability to see; a picture in your imagination; your own point of view on a problem.	
7	A strong but soft kind of plastic that is bent easily and is used to cover walls, floors, furniture, books, etc.	
8	A synonym to the words “screen”, “monitor”.	

8. Match the following words.

• cup • a game • information • frame • display
• supplied • device • included • vision
• gadget • the world • for people

1	a perfect		7	around	
2	a useful		8	batteries	
3	metal		9	not	
4	to deflect		10	suction	
5	helpful		11	be perfect	
6	LCD		12	to enjoy	

9. Make a list of 5 gadgets that you use. How useful are they? Put them in order (1 — the most useful; 5 — the least useful). Try to explain your choice to the others.

10. Think of a gadget that you often use. Don’t name it. Describe it to your groupmates. Try to answer the following questions.

— Where is it used?
— Who uses it?
— What is it used for?
— Why is it useful?
— What is it made from?

— What powers the gadget?
— How much does it cost? Etc.

Can they guess the gadget?

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 18*, *pg. 20*, *Ex. 6*, *7.*)

11. Search the Internet or other sources to find the most strange and unusual gadgets. Tell about them to your group.

12. Translate the following sentences into Russian. Translate the idea, not word for word.

1. This car has all the latest gadgets.
2. People have a lot of different gadgets at home.
3. Which gadget is the most useful?
4. "How can I open the bottle? "—"The gadget is in the right drawer."
5. A lot of different gadgets are invented each year.
6. Gadgets are invented not only by scientists but by ordinary people as well.
7. This company supplies tools to our manufacture.
8. Implants are out of supply at the moment.
9. When you buy toys, the batteries are usually not supplied.
10. The production process was stopped because the components had not been supplied.
11. The price includes the flight, the hotel, and food.
12. The crew included one woman.
13. Engineering includes several branches.
14. A wireless mouse was included in the price of a laptop.
15. I was included into the project.
16. Frames can be made from wood, metal, or plastic.
17. Nowadays glasses with a metal frame are out of fashion.
18. Each pack contains 12 batteries.
19. This bottle contains acid. Don't handle it!
20. How many pages does this manual contain?
21. What kind of information does this manual contain?
22. These new glasses deflect your vision by 90°.
23. Do you think that bed glasses with a vision deflection are really useful?

24. Vinyl is a kind of plastic.
25. Do you think that vinyl mat is useful in the bathroom?
26. Nowadays vinyl is used practically everywhere.
27. She has the same vision of the problem!
28. Bed glasses deflect your vision by 90°.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. GADGETS

Read the text and fill in the gaps with the following words.

• monument • invention • object
• discussed • normal • tool

A gadget is a small technological (*1*) ___________ (such as a device or an appliance) that has a particular function, but is often thought of as a novelty (= new thing). Gadgets are considered to be more unusually or cleverly designed than (*2*) ___________ technological objects at the time of their (*3*) ___________.

The origins of the word "gadget" trace back to the 19th century. According to the *Oxford English Dictionary*, there is anecdotal evidence for the use of "gadget" as a placeholder name for a technical item whose precise name one can't remember since the 1850s. The etymology of the word is still being (*4*) ___________. A widely circulated story holds that the word gadget was "invented" when Gaget, Gauthier & Cie, the company behind the construction of the Statue of Liberty (1886), made a small-scale version of the (*5*) ___________ and named it after their firm; however this contradicts the evidence that the word was already used before in nautical circles, and the fact that it did not become popular, at least in the USA, until after World War I. Other sources cite a derivation from the French *gâchette* which has been applied to various pieces of a firing mechanism, or the French *gagée*, a small (*6*) ___________ or accessory.

• designed • supplied • services
• industries • software • enjoy
• engineering • batteries • perfect

Today, the term is widely used in a variety of (*7*) ___________ and activities. It can refer to tools and toys, also to "smartphones", GPS navigation devices, key finders, USB toys, and radio-controlled cars, etc. Some of them need (*8*) ___________ (that may be included or may not be (*9*) ___________) and some can be used on their own. Most of them are designed to (*10*) ___________ people. Some of them are (*11*) ___________ for children, some—for grown-ups, and some are (*12*) ___________ specially for sick people to use. Gadgets may be cheap or cost much money.

In the (*13*) ___________ industry, "gadget" refers to computer programs that provide (*14*) ___________ without needing an independent application to be launched for each one, but instead run in an environment that manages multiple gadgets. There are several implementations based on existing software development techniques, like JavaScript, form input, and various image formats. The earliest documented use of the term "gadget" in context of software (*15*) ___________ was in 1985 by the developers of AmigaOS, the operating system of the Amiga computers (*intuition.library* and also later *gadtools.library*). It means what other technological traditions call GUI widget—a control element in graphical user interface. This naming convention remains in continuing use (as of 2008) since then.

2. INSPECTOR GADGET

1. **Read the text and fill in the gaps (a—g) with the following words.**

• activate • gadgets • character • electronic
• humoristic • adapted • gadgets

2. **Match the following names of gadgets with the gaps (1–15) in the text.**

• Ears • Springs • Top-Secret Gadget Phone
• Tie • Helicopter • Respirator • Skates
• Binoculars • Radar • Legs/Arms/Neck
• Brella • Hands • Flower • Periscope • Siren

"Inspector Gadget" is a (*a*) ___________ animated television series developed in joint-venture between France, Canada, the United States, Taiwan, and Japan about a clumsy, simple-witted detective named Inspector Gadget, who is a human being with various bionic (*b*) ___________ built into his body. Gadget's arch-nemesis is Dr Claw, the leader of an evil organization, known as "M.A.D."

This was the first syndicated cartoon show from DIC Entertainment. It originally ran from 1983 to 1986 and remained in syndication into the late 1990s.

The series was a co-production between DIC Entertainment (now Cookie Jar Entertainment) in France (the main headquarters did not move to the US before 1987) and Nelvana in Canada; the animation work was outsourced to foreign studios such as Tokyo Movie Shinsha in Japan and Cuckoo's Nest Studio in Taiwan.

In 1999, it was (*c*) ___________ into a live-action Disney film starring Matthew Broderick as the main (*d*) ___________ and Rupert Everett as Doctor Claw.

The most commonly used gadgets are:

— Gadget (*1*) "___________": This lowers down out of his hat and over his eyes. It helps to watch objects at distance.
— Gadget (*2*) "___________": A hand holding an umbrella that comes out of his hat. It can be used as a parachute.
— Gadget "Coat": His trench coat inflates when he pulls one of its buttons and enables him to float—in water or in the sky.
— Gadget (*3*) "___________": Propeller blades come out of his hat and enable him to fly. Gadget has a second, "Spare" unit available in the event of failure.
— Gadget "Cuffs": A handcuff comes out of his forearm just above his hand.
— Gadget (*4*) "___________": Several mechanical objects can pop out of Gadget's hat. They sometimes hold various objects including a camera, a motorized fan, a spotlight, a can opener, and other useful things. Of course, there are times when they will also be holding something useless or unhelpful to the situation.
— Gadget (*5*) "___________": These parts of his body can telescope and extend to great lengths. Embedded into his left hand is a crank that can be used to retract the arm.
— (*6*) "___________": A telephone in his hand. The earpiece is in his thumb, while the mouthpiece is in his little finger. This is one of the few gadgets that is not voice-activated; instead, Chief Quimby activates it by calling Gadget. (There is also a regular telephone inside Gadget's hat.)

— Gadget (*7*) "___________": Rollers come out of the bottom of his shoes and let him move quickly on the road. He is often very clumsy and struggles to keep his balance on the road.
— Gadget (*8*) "___________": This thing comes out of his hat, enabling him to bounce (= to jump), usually when falling head first and hitting his head against the ground. His legs can also extend with springs, which he uses often for jumping and landing.

In addition there are some other gadgets that are used by Inspector Gadget for the benefit of his mission:

— Gadget (*9*) "___________": A mechanical hand holding a big sunflower emerges from his hat and can either spray water or sleep gas towards an enemy.
— Gadget (*10*) "___________": Metal cones that deploy from his head, around his ears, allowing him to hear better.
— Gadget "Lanyard": A mechanical lanyard extends from his belt buckle allowing him to attach himself to various objects.
— Gadget "Flaps": Mechanical flaps extend from his waist allowing him to glide smoothly, often used in conjunction with the above allowing him to attach to various forms of transport and escape precarious situations.
— Gadget "Hat Doff": When Gadget greets a lady, instead of doffing his hat, a mechanical hand emerges from his hat, in the hand is another hat; from this other hat emerges a second mechanical hand, which is also holding a hat. This gadget was only seen once in the film.
— Gadget (*11*) "___________": His hat opens and this thing emerges to see over high objects or when underwater. It also helps to deflect vision.
— Gadget (*12*) "___________": This thing on the Inspector's neck becomes a lasso.
— Gadget "Magnets": Magnets come out of the bottom of his shoes. More often than not, the magnets end up sticking to any metallic object with a magnetic attraction, just like Captain Planet's "magnetic" personality. It is sometimes useful when attempting to avoid slipping on slippery surfaces.
— Gadget "Mallet": A wooden hammer held in a robotic hand that also comes out of his hat.

- — Gadget “Parachute”: A relatively small, red parachute which was used only once. He usually relies on the “Brella”.
- — Gadget (*13*) “___________”: A self-contained breathing mask and the only gadget that Gadget has to physically reach for and pull on as he said his “Go-Go-Gadget” command for it.
- — Gadget “Refridge-a-Gadget”: A gloved hand holding an unmarked aerosol can appear out of his hat and spray a substance that immediately reduces the surrounding area to subzero temperatures. This gadget was only used in Gadget’s Gadgets.
- — Gadget (*14*) “___________”: A police light and sound emerge from the top of his hat, it is used in the starting credits.
- — Gadget “Skis”: a pair of skis that extend out of the front and back of his shoes.
- — Gadget “Teeth”: Gadget’s teeth deploy from his mouth and fly about.
- — Gadget “Wind Sail”: A huge wind sail emerges from his hat, which, when combined with Gadget “Skis”, allows him to wind sail down a snowy track.
- — Gadget (*15*) “___________”: It emerges from his hat and “feels” the objects around.
- — Gadget “Pulley”: A mechanical hand holding a pulley on a handle emerges from Gadget’s hat to allow him to travel down a gondola cable.
- — “Finger” Gadgets: There are several gadgets inside his fingers, accessed by taking the end off his finger to expose the gadget. These include a flashlight, skeleton key, laser, pen, screwdriver, drill bit, snow gun, corkscrew, water pistol, and whistle.

The Inspector can (*e*) ___________ each of his gadgets by calling its name, “Go-Go-Gadget Arms!” (for example), but there are times when gadgets appear to be activated by reflex rather than being called. The Inspector also activates some of his (*f*) ___________ (such as a third hand in his hat, and his extending neck) by simply thinking about it, which is accompanied by a “thinking” or “computer is busy” (*g*) ___________ sound effect.

Part III

(режим доступа для просмотра видеороликов http://englishtech.ru/video/modul_15/)

1. THE LATEST TECHNOLOGY GADGETS (02:40)

Pre-listening

1. *What is a gadget?*
2. *What latest gadgets can you name? Make a list.*
3. *Which from your list is the most important for you? Why?*
4. *Study the following words and phrases.*

   To project, to magnify, (to) clip, magnetic field.

While-listening

Watch the whole video track and answer the following question.

5. *How many gadgets are described in the text?*

Watch the video track **part by part** and answer the following questions.

00:00—00:47

6. *What gadget is described?*
7. *What can you do with this gadget?*
8. *Why is it so useful?*
9. *Which synonym is used instead of the word "comfortable"?*
10. *How does it work? Fill in the gaps in the following text with the words you hear?*

The keyboard (*1*) ___________ by projecting red diode laser (*2*) ___________ through the refracting field shaped like a (*3*) ___________. A lens magnifies and (*4*) ___________ the light ... into any flat surface ... and (*5*) ___________ the motion of user's (*6*) ___________ and communicates the (*7*) ___________ wirelessly to the receiving (*8*) ___________.

00:48—01:10

11. *What gadget is described?*
12. *What is its capacity?*

13. *How is it connected to a computer?*
14. *How does it work?*

01:11—01:47

15. *What gadget is described?*
16. *How many elements are included in this gadget?*
17. *What is the capacity of a clip?*
18. *What can you do with this gadget?*
19. *How is it connected to a computer?*
20. *How does it work? Fill in the gaps in the following text with the words you hear.*

(*1*) ___________ on the pen's tip (*2*) ___________ a radio (*3*) ___________ to the clip on the (*4*) ___________ of the page. It (*5*) ___________ the position of the (*6*) ___________.

01:48—02:32

21. *What gadget is described?*
22. *What is its capacity?*
23. *What can you do with this gadget?*
24. *How small are the capsules inside the display screen?*
25. *What makes negatively charged black sides and positively charged white sides in capsules inside the display screen change their position?*

Post-listening

26. *What gadgets shown in the track, do you think, are of great importance?*
27. *Why do people design gadgets?*
28. *What kind of gadget would you like to be designed?*

2. VW TOUAREG GADGETS
(02:30)

Pre-listening

1. *What is a gadget?*
2. *What gadgets do cars usually have?*

While-listening

Watch the whole video track. Match the phrases from columns A, B and C in the table below to form sentences in order to answer the following question.

3. *What can you do with the VW Touareg gadget that is shown in the track? You can...*

A	B	C
set	the disposition of a virtual picture	to choose options.
see	the parameters	in front of your car.
project	temperature	while navigating your car.
use	the road	on the road.
watch	sensor display	for a driver and a passenger.
set	the Russian language	behind your car.
navigate	the virtual position of your car	of climate control.
use	the direction of wheels	of your car, moving along the road.
change	the road	on the road.
watch	your car	of your car.

Post-listening

4. *Think of similar sentences about other car gadgets. What can you do with...? You can...*

3. THE BEST JAMES BOND GADGETS (04:52)

Pre-listening

1. *Do you know James Bond? Do you remember any of films with him? Do you remember any of gadgets that he used?*
2. *Do you know the following words and phrases?*

   Mission, to crack, a missile, spectrum, a gun, space, to discover, to prevent, to break out, to accompany, to identify, to seize a control, water supply.

While-listening

Watch the whole video track and answer the following questions.

3. *How many gadgets that were used by James Bond are described in the text?*
4. *What are they?*

Watch the video track **part by part** and answer the following questions:

00:00—00:20

5. *How did James Bond complete his missions?*
6. *What helped James Bond to complete missions?*

00:21—00:25

7. *Complete the following sentence with the words you hear.*

Let's take a (*1*) ___________ at some of the (*2*) ___________ Bond (*3*) ___________ and how they were worn over the last (*4*) ___________ years.

00:26—01:05

8. *Complete the following with the words you hear.*

...Early car (*1*) ___________ had been around for (*2*) ___________ years. But these were essentially (*3*) ___________-wave (*4*) ___________ with the (*5*) ___________ to the existing lane-line grid because it (*6*) ___________ in the same spectrum as most "walky-talkies".

9. *When did car phones become commercially available?*

01:06—01:47

10. *Complete the following with the words you hear.*

...The safe (*1*) ___________ was the (*2*) ___________ of (*3*) ___________. Real (*4*) ___________ crackers at the time used listening (*5*) ___________, (*6*) ___________and other more destructive (*7*) ___________.

11. *When and where was an auto-dialer designed?*
12. *What was the most advanced lock ever built?*

01:48—02:08

13. *When did ray-guns stop being simply fictional toys?*
14. *What company began manufacturing laser weapons?*

02:09—02:27

15. Where is the scene of "The Moonraker" set?

02:28—02:52

16. What is special about the boombox shown in the track?
17. When did German police discover the hand guns?
18. What were these hand guns like?

02:53—03:35

19. What did James Bond have to do in "Tomorrow never dies"?

03:57—04:31

20. What mission is James Bond completing in the film mentioned in this part of the track?
21. What is the name of organization that accompanies the idea of creation of implants to identify pets and human?

Watch the video track again and complete the following table.

22. Fill in the gaps in the following table.

Year	**Gadget**	**Name of the film**	**Name of an actor as James Bond**
1963			Sean Connery
	a safe-cracker	On Her Majesty's Secret Service	George Lazenby
	laser	Moonraker	Roger Moore
1987		The Living Daylights	
	a remote-controlled car		Pierce Brosnan
2008		Quantum of Solace	

Post-listening

23. Which of these gadgets is/are of most importance? Why?
24. Which of these gadgets is/are widely used nowadays?

16. BRIDGES

Part I

1. **Why do people build bridges? Where are bridges usually built?**
2. **Read the text quickly and choose the correct answers to the questions below. Don't pay attention to the gaps.**
   1. Where is the text from?
      (a) An engineering book about bridges.
      (b) A tourist guidebook.
   2. Which is the best title for the text?
      (a) The Clifton Suspension Bridge.
      (b) Isambard Kingdom Brunel.

The *CLIFTON SUSPENSION BRIDGE* is a (*1*) ___________ bridge which means it doesn't open or move to allow boats through. It was (*2*) ___________ in the 1830s by one of Britain's greatest 19th-century (*3*) ___________, Isambard Kingdom Brunel. The bridge was actually (*4*) ___________in the 1860s. (*5*) ___________ analysis of the design shows that many of the ideas are almost (*6*) ___________.

When the bridge opened, it was for carriages pulled by horses but 150 years later it carries 12,000 cars and lorries a day, that's over four million (*7*) ___________ a year.

Strange but true:

In 1885, a young woman jumped off the Clifton Suspension Bridge. Her large, fashionable, 19th-century skirt acted as a (*8*) ___________ and she landed safely after a 75 m fall. She lived into her seventies.

The first (*9*) ___________ flew under the bridge in 1911. The last plane was a jet travelling at 720 kph in 1957; the (*10*) ___________ crashed the plane and died.

(*"Engineering" Workshop by Lindsey White, OUP; Unit 19, pg. 22, Ex. 2.*)

3. Read the text again and complete the gaps with the following words.

• aeroplane • built • computer
• designed • engineers • fixed
• parachute • perfect • pilot • vehicles

(*"Engineering" Workshop by Lindsey White, OUP; Unit 19, pg. 22, Ex. 3.*)

4. Read the text again and find the English equivalents to the following expressions.

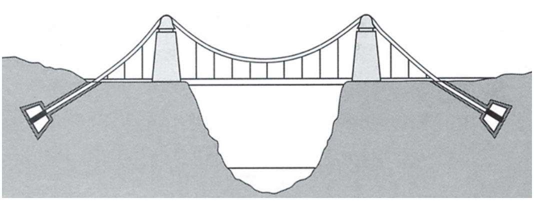
Что означает; он был разработан; он предназначался для; спустя ... лет; в день; в год; безопасно приземлилась; до 70 с лишним лет; летевший со скоростью.

5. Read the text again and decide if the following sentences are true (T) or false (F).

1	The Clifton Suspension Bridge is a moveable bridge.	T	F
2	It was designed and built in the 20th century.	T	F
3	The designer was a famous British engineer.	T	F
4	The design of the bridge is very good.	T	F
5	Pilots fly under the bridge every day.	T	F

(*"Engineering" Workshop by Lindsey White, OUP; Unit 19, pg. 22, Ex. 4.*)

6. Look at the diagram below and write the dimensions in the correct places.



Dimensions:
span—214 m;
height above
the river—75 m;
height of towers—26 m

(*"Engineering" Workshop by Lindsey White, OUP; Unit 19, pg. 22, Ex. 5.*)

7. Look at the following words. Check the meaning of any new words in the glossary. What do you think the next text will be about?

• bridge • collapse • cracked • disaster
• enquiry • killed • substandard

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 20*, *pg. 23*, *Ex. 2.*)

8. Read the following text. What is it about?

The *TAY BRIDGE* in Scotland was designed and built by Sir Thomas Bouch in the 19th century. The bridge, which was over 3 km long, opened in 1878 and fell down in a winter storm in 1879. A train carrying 70 people was on the bridge at the time and all people were killed.

There was an enquiry into the Tay Bridge disaster to find out why the accident happened. One of the conclusions was that the design and construction were based on how quickly and cheaply it could be built; safety and strength were not thought about properly. Another conclusion was that it was a very cold winter and the iron may have cracked when it contracted. Also, the design was based on experience rather than the more scientific and accurate calculations used today.

During the 20th century engineers used computers to do a detailed structural analysis of the design used for the Tay Bridge. The results confirm that the design of the bridge was definitely substandard.

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 20*, *pg. 23*, *Ex. 3.*)

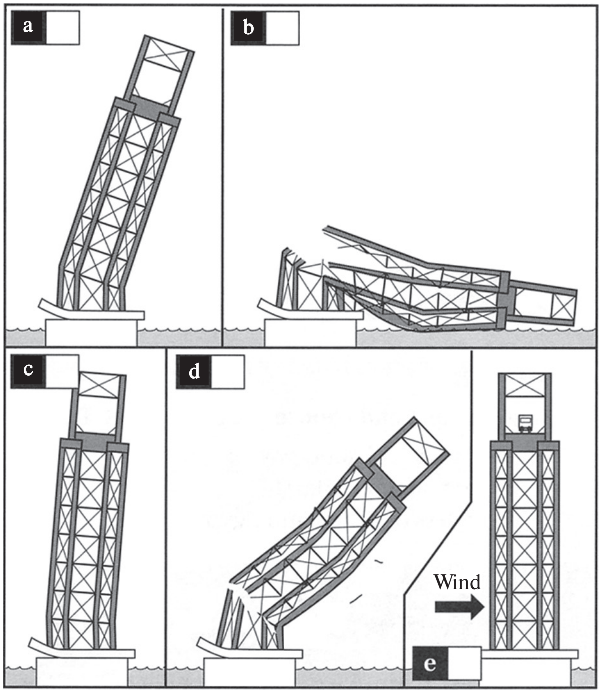
9. Read the text again and find the English equivalents to the following expressions.

Был разработан и построен; длиной свыше ... километров; в это время; чтобы выяснить; были основаны на; следующий вывод; научный и точный расчет; детальный структуральный анализ; результаты доказывают, что; абсолютно непригоден.

10. Find the English equivalents to the following phrases. Mind that the phrase given can easily replace the phrase used in the text without any change in meaning.

To get to know; the reason of the accident; spending less money; were forgotten; absolutely not acceptable.

11. Read how the Tay Bridge collapsed. Match the sentences (1–5) with the diagrams (a–e) below.



1. There was strong wind when a train was crossing the bridge.
2. The base of one of the columns lifted.
3. This (lifting) caused the strengthening parts of the structure to collapse.
4. The whole structure started to fall.
5. While the structure was falling, the girders collapsed in the opposite direction, causing the pier to collapse completely.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 20*, *pg. 23*, *Ex. 4.*)

12. Match the following words with their definitions.

• disaster • analysis • bridge • to crack
• girder • span • height • to collapse
• enquiry • dimension

1	The measurement from the bottom to the top.	
2	A structure that carries a road or railway across a river.	
3	The length of something from one end to the other.	
4	The careful examination of the different parts or details of something.	
5	To fall down or break into pieces suddenly.	
6	To break or to make something break so that a line appears on the surface without breaking into pieces.	
7	An event that causes a lot of harm or damage; terrible situation.	
8	A question or number of questions that you ask about something in order to get more information.	
9	A long heavy piece of iron or steel that is used in bridge (or building) construction.	
10	A measurement of the length, width, or height of something; the size of something.	

13. Match the following words.

• construction • disaster • calculation • of tower
• the design • on experience • direction • designed
• bridge (×3) • analysis (×2) • dimensions

1	moveable		8	2 or 3	
2	height		9	be based	
3	accurate		10	opposite	
4	detailed		11	suspension	
5	analysis of		12	structural	
6	bridge		13	fixed	
7	was		14	natural	

14. Answer the following questions about bridges in the texts above.

1. What are the main dimensions of a bridge?
2. What kind of bridge is the Clifton Bridge?
3. What does the word “fixed” mean?
4. Which word is the opposite to the word “fixed”?

5. What should be done before the beginning of a bridge construction?
6. What happened to the Tay Bridge construction?
7. What does the word “substandard” mean?
8. Why did the Tay Bridge in Scotland collapse?
9. What do we call such events as the Tay Bridge collapse?
10. What was organized after the Tay Bridge collapse?
11. What was the aim of this enquiry?
12. What were the conclusions of the analysis of the Tay Bridge disaster?
13. What may happen to people during a disaster?
14. What are girders usually made of?

15. Translate the following sentences into Russian. Translate the idea, not word for word.

1. Let’s check your height and weight.
2. The height of this bridge is about 50 m.
3. Some people are afraid of height.
4. The height of this building is over 75 m.
5. What is the height of this construction?
6. The height is one of three dimensions of an object in space.
7. Where is the Clifton Suspension Bridge situated?
8. How long is the Clifton Bridge?
9. How many bridges over Kazanka River are there?
10. What is the span of the Millennium Bridge in Kazan?
11. What is the span of wings of this bird?
12. Find out the span of this bridge and write it in the correct place on the picture.
13. Send this water to the laboratory for analysis.
14. This plastic should be sent for analysis.
15. A group of highly-skilled engineers were asked to do a professional analysis of the bridge construction.
16. The equipment was not of good quality and was sent for analysis.
17. Analyse the situation and design a solution.
18. A lot of buildings collapsed during the earthquake.
19. There was a collapse of the motorway bridge two days ago.
20. Suddenly the construction collapsed.

21. At first constructions crack and then crash.
22. A crack could be seen on a wall of the building.
23. Plastic may crack in cold.
24. Metal contracts in cold.
25. Earthquake is a natural disaster.
26. Always put on your safety equipment at work in order to avoid the disaster.
27. The fall of the Tay Bridge in Scotland was a serious disaster.
28. Accurate calculations must be done in order to prevent disaster.
29. I'd like to make an enquiry about the place of a welder.
30. Before you start a course you should make an enquiry about it.
31. Make an enquiry into the Internet resources.
32. Girders are normally used in constructions.
33. What are girders made of?
34. Girders in a construction may crack if accurate calculations were not done properly.

16. Translate the following sentences into English. Translate the idea, not word for word.

1. Этот мост был построен в 1950 году.
2. Этот мост был спроектирован известным инженером.
3. При проектировании этого здания научными расчетами занимались высококвалифицированные специалисты.
4. До начала строительства этого здания был проведен детальный анализ.
5. Для проведения детального анализа сегодня используют компьютерные технологии.
6. В Санкт-Петербурге много «подвижных» мостов.
7. Разводные мосты строят для того, чтобы пропускать суда.
8. Подвесной мост является разновидностью мостов.
9. Протяженность этого моста составляет более трех километров.
10. Неожиданно здание рухнуло.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. BRIDGES

1. Read the text and fill in the gaps with the following words.

• bridges • constructed • structure • stones
• languages • Design • material

A bridge is a (*1*) ___________ built to span a valley, road, body of water, or other physical obstacle, for the purpose of providing passage over the obstacle. (*2*) ___________ of a bridge depends on the function of a bridge, the nature of the terrain (= place, territory) where the bridge is (*3*) ___________, the (*4*) ___________ used to make it and the funds (= money) available to build it.

The *Oxford English Dictionary* tells us that the origin of the word bridge comes from an Old English word *brycg*, of the same meaning, derived from a hypothetical Proto-Germanic root *brugjō*. There are cognates in other Germanic (*5*) ___________ (for instance *brücke* in German, *brug* in Dutch, *brú* in Icelandic, *brúgv* in Faroese, or *bro* in Danish, Norwegian and Swedish).

The first (*6*) ___________ appeared in ancient times. They were made by nature itself—for example, a log fallen across a river or (*7*) ___________ in the water. The first bridges made by humans were constructed with the help of wooden logs which served as girders, stones, long bamboo sticks, or other harvested fibers which were woven together to form a connective rope.

One of the oldest arch bridges, the Arkadiko Bridge, is one of four Mycenaean arch bridges and part of a former network of roads in the Peloponnese, in Greece. Dating to the Greek Bronze Age (13th century B.C.), the bridge is still in existence and use.

• designed • commercial • type • builders
• presented • built • cement • engineering

The greatest bridge (*8*) ___________ of antiquity were the ancient Romans. The Romans built arch bridges and aqueducts that could stand in conditions that would damage or destroy earlier designs. Some stand today. An example is the Alcántara Bridge, built over the river Tagus, in Spain. The Romans also used (*9*) ___________ for construction. One type of cement, called *pozzolana*, consisted of water, lime, sand, and volcanic rock.

The use of stronger bridges using plaited bamboo and iron chain was visible in India by about the 4th century. A number of bridges, both for military and (*10*) ___________ purposes, were constructed by the Mughal administration in India.

The oldest surviving stone bridge in China is the Zhaozhou Bridge, (*11*) ___________ from 595 to 605 A.D. during the Sui Dynasty. This bridge is also historically significant as it is the world's oldest stone segmental arch bridge.

Rope bridges, a simple (*12*) ___________ of suspension bridge, were used by the Inca civilization in the Andes mountains of South America, just prior to European colonization in the 1500s.

During the 18th century there were many innovations in the design of timber bridges (= made of wood). The first book on bridge (*13*) ___________ was written by Hubert Gautier in 1716. With the Industrial Revolution in the 19th century, truss systems of wrought iron were developed for larger bridges. In 1927 welding pioneer Stefan Bryła (*14*) ___________ the first welded road bridge in the world, which was later built across the river Słudwia Maurzyce near Łowicz, Poland in 1929. In 1995 the American Welding Society (*15*) ___________ the Historic Welded Structure Award for the bridge to Poland.

2. Read the text again and say if the following statements are true (T) or false (F).

1	A lot of factors influence the design of a bridge.	T	F
2	The word "bridge" has similar roots in Germanic languages.	T	F
3	Different kinds of natural objects were used to make first bridges.	T	F
4	There are no ancient bridges that are still in use.	T	F
5	Ancient Greeks were the first to use cement.	T	F
6	A reward was given to a European country for the bridge construction by a famous organization from the USA.	T	F

2. TYPES OF BRIDGES

1. Look at the pictures of bridges. Read the text. Match the pictures (a–h) with the types of bridges (1–8) mentioned in the text.

There are many different types of bridges. The classification is based on the purpose of usage, bridge dimensions, structure of the bridge, the material used in the construction, etc. Sometimes a bridge belongs to more than one type. The most commonly used are the following types:

1. Beam bridges

Beam bridges are horizontal beams (= girders) supported at each end by piers. The earliest beam bridges were simple logs across streams and similar simple structures. In modern times, beam bridges are large box steel girder bridges. Weight on top of the beam pushes straight down on the piers at either end of the bridge. They are made up mostly of wood or metal. Beam bridges typically do not exceed 250 feet long. The longer the bridge, the weaker it is.

2. Cantilever bridges

Cantilever bridges are built using cantilevers — horizontal beams that are supported on only one end. Most cantilever bridges use two cantilever arms extending from opposite sides of the obstacle to be crossed, meeting at the center. The largest cantilever bridge is the 549-meter (1,801 ft) *Quebec Bridge* in Quebec, Canada.

3. Arch bridges

Arch bridges are arch-shaped and have abutments at each end. The earliest known arch bridges were built by the Greeks and include the *Arkadiko Bridge*. The weight of the bridge is thrust into the abutments at either side. Dubai in the United Arab Emirates is currently building the *Sheikh Rashid bin Saeed Crossing*, which is going to be completed in 2012. When completed, it will be the largest arch bridge in the world.

a

b

c

d

e

f

g

h

4. Suspension bridges

Suspension bridges are suspended from cables. The earliest suspension bridges were made of ropes or vines covered with pieces of bamboo. In modern bridges, the cables hang from towers that are attached to caissons or cofferdams. The caissons or cofferdams are implanted deep into the floor of a lake or river. The longest suspension bridge in the world is the 12,826 feet (3,909 m) *Akashi Kaikyo Bridge* in Japan.

5. Cable-stayed bridges

Like suspension bridges, cable-stayed bridges are held up by cables. However, in a cable-stayed bridge, less cable is required and the towers holding the cables are proportionately shorter. The first known cable-stayed bridge was designed in 1784 by C.T. Loescher. The longest cable-stayed bridge is the *Sutong Bridge* over the Yangtze River in China.

6. Truss bridges

Truss bridges are composed of connected elements. They have a solid deck and a lattice of pin-jointed or gusset-joined girders for the sides. Early truss bridges were made of wood, and later of wood with iron tensile rods, but modern truss bridges are made completely of metals such as wrought iron and steel or sometimes of reinforced concrete. The *Quebec Bridge*, mentioned above as a cantilever bridge, is also the world's longest truss bridge.

7. Movable bridges

Some bridges are not fixed crossings, but can move out of the way of boats or other kinds of traffic which, ideally, moves under them, but is sometimes too tall to fit. These are generally electrically powered.

8. Double-decked bridges

Double-decked, or double-decker, bridges have two levels, such as the *San Francisco—Oakland Bay Bridge*, with two road levels. *Tsing Ma Bridge* and *Kap Shui Mun Bridge* in Hong Kong have six lanes on their upper decks, and on their lower decks there are two lanes and a pair of tracks for MTR metro trains. Likewise, in Toronto, the *Prince Edward Viaduct* has four lanes of motor traffic on its upper deck and a pair of tracks for the Bloor—Danforth subway line. Some double-decker bridges only use one level for street traffic; the *Washington Avenue Bridge* in Minneapolis reserves its lower level for automobile traffic and its upper level for pedestrian and bicycle traffic (predominantly students at the University of Minnesota).

Robert Stephenson's *High Level Bridge* across the river Tyne in Newcastle upon Tyne, completed in 1849, is an early example of a double-decked bridge. The upper level carries a railway, and the lower level is used for road traffic. Another example is *Craigavon Bridge* in Derry, Northern Ireland. The *Oresund Bridge* between Copenhagen and Malmö consists of a four-lane highway on the upper level and a pair of railway tracks at the lower level.

The *George Washington Bridge* between New Jersey and New York has two roadway levels. A truss work between the roadway levels provides stiffness to the roadways and reduced movement of the upper level when installed. *Tower Bridge* is another example of a double-decker bridge, with the central section consisting of a low level bascule span and a high level footbridge.

2. Read the text again and find the answers to the following questions.

1. The name of which bridge is used in the text as an example twice?
2. Which type of bridges can let pass different kinds of vehicles and people, and its traffic capacity is very high?
3. Which type of bridges needs mechanical or electrical power to be used properly?
4. In what type of bridges does the safety of a bridge depend on its length, and the length can't be more than officially stated?
5. The name of which type of bridges is also found in architecture of buildings?
6. What type of bridges that is situated in Japan is the longest in its kind?
7. In what types of bridges are cables used?
8. Which type of bridges has "walls" made of girders on both sides which are situated sometimes above the deck and sometimes under it?

3. BRIDGE FAILURES

Read the text and fill in the gaps with the following words.

• Bridge • designs • disasters • materials
• analysis • construction • accurate

The failure of bridges is of special concern for structural engineers in trying to learn lessons vital to bridge design, (*1*) ___________, and maintenance. The failure of bridges first became a national interest during the Victorian era when many new (*2*) ___________ were being built, often using new (*3*) ___________.

(*4*) ___________ construction needs scientific and (*5*) ___________ calculations and detailed structural (*6*) ___________ of the design in order to avoid (*7*) ___________. But still accidents happen.

• civil • structure • suspension
• constructed • collapsed • completed

1. Egyptian Bridge in St Petersburg, Russia, carries Lermontov Avenue over the Fontanka River. It replaced the one-span (*8*) ___________ bridge that was of historical interest as a monument to early 19th-century Egyptomania. It was (*9*) ___________ in 1825–1826 by two (*10*) ___________ engineers, Von Traitteur and Christianowicz. Its granite abutments were topped with cast-iron sphinxes and hexagonal lanterns. An unusual feature was a pair of cast-iron gates featuring Egyptian-style columns, ornaments, and hieroglyphics, with many details of the ironwork covered with gold.

The original bridge, used by both pedestrians and horse-drawn transport, (*11*) ___________ on January 20, 1905, when a cavalry squadron was marching across it. The present (*12*) ___________, incorporating sphinxes and several other details from the 19th-century bridge, was (*13*) ___________ in 1955.

• connection • projects • idea
• collapse • built • destroyed

2. The Kerch Strait bridge is a proposal for a bridge spanning the Strait of Kerch between the Chushka Spit, Taman Peninsula, Russia and the

Kerch Peninsula, Crimea, Ukraine. Currently (*14*) __________ is by car ferry between Port Kavkaz and Port Krym.

The (*15*) __________ of this bridge appeared first in early 1943 and was originated by Albert Speer. He hoped that the bridge would help organize the German invasion of the Northern Caucasus. The 4500-metre bridge was actually (*16*) __________ in summer 1944 after the liberation of the Crimea by the Red Army from the materials left on the site by the Wehrmacht. The bridge was (*17*) __________ within six months by flowing ice.

Since 1944, various bridge (*18*) __________ to span the strait have been proposed or attempted. The idea of a Kerch Strait bridge appeared again after the (*19*) __________ of the Soviet Union, but in 1994 the Russian and Ukrainian sides failed to finalize the project. Moscow mayor Yuri Luzhkov (1992–2010) was a vocal advocate for a highway bridge across the strait, expressing hope that it would bring the Crimeans closer to Russia, both economically and symbolically.

• collapsed • builders • enquiry • reconstruct • collapse
• traffic • accident • automobile • important • company

3. A bridge (*20*) __________ in Yekaterinburg, Russia, happened on September 6, 2006. The (*21*) __________ bridge that was under construction in the centre of Yekaterinburg collapsed at the crossing of Shevchenko and Vostochnaya Streets on Monday afternoon. Three of 10 reinforced-concrete beams (= girders) of the bridge span above the railway fell onto the rail tracks. Traffic along Vostochnaya Street that is one of the main highways of the city was blocked. Railway (*22*) __________ was also paralysed. A total of 111 freight trains and 104 passenger trains were delayed. Changes to the train schedule caused big costs. However, the railway tracks had not been damaged.

Work to dismantle the other six remaining beams was conducted through the joint efforts of railwaymen and (*23*) __________. The bridge beams were first separated from one another by slits and then lowered to the ground by means of emergency train jibs.

At first, it was said that possible causes could include a mistake made by builders, but this was unlikely because the contractor was a very reliable (*24*) ___________. But later an (*25*) ___________ was organized to find out the reason of the (*26*) ___________ and it was stated that a gross design mistake might have caused the collapse of the bridge. The bridge (*27*) ___________ because construction works were conducted with a violation of a city-building codex. Also, director didn't send a bridge design documents for public examination and didn't receive an approval for construction of the bridge.

Then it was decided to (*28*) ___________ the bridge as it was an (*29*) ___________ element of transport infrastructure.

Part III

(режим доступа для просмотра видеороликов
http://englishtech.ru/video/modul_16/)

1. ANCIENT BRIDGE BUILDING TECHNIQUES (01:50)

Pre-listening

1. *What is a bridge?*
2. *Why do people build bridges?*
3. *When did people begin bridge building?*
4. *What were ancient bridges made from?*
5. *What type of bridges do you know?*
6. *Study the following words and phrases.*

   To go on, practitioner, arch bridge, nail, to cover something with something, covering, to extend, landmark.

While-listening

Watch **the parts** of the video track and answer the following questions.

00:00—00:07

7. *What is going on in Beijing?*
8. *What is being demonstrated?*

00:08—00:19

9. *Fill in the gaps in the following text with the words you hear.*

The (*1*) ___________ of various art forms are in the (*2*) ___________ capital to (*3*) __________ the (*4*) __________. And (*5*) __________ let's take a look at a (*6*) ___________ of bridge (*7*) ___________.

00:20—01:18

10. *What type of bridge is being constructed?*
11. *How much time is going to be spent for its construction?*
12. *What is special about this bridge?*
13. *When did this technology appear?*
14. *Where are "covered" bridges popular and why?*

15. *Why do bridges need the covering?*
16. *What is the other use of "covered" bridges?*

01:19—end

17. *What did "covered" bridges serve as in ancient times?*

Post-listening

18. *Find information about any ancient bridge and present it to your group.*

2. THE GREAT HISTORY OF TOWER BRIDGE (02:05)

Pre-listening

1. *What is a bridge?*
2. *Why do people build bridges?*
3. *Where is the Tower Bridge situated?*
4. *Study the following words and phrases.*

Contractor, jubilee, to celebrate, centenary.

While-listening

Watch the video track and answer the following questions.

5. *What river does this bridge cross?*
6. *When was it built?*
7. *Are people allowed to visit towers?*
8. *What can people do there?*
9. *How long was the Tower Bridge under construction?*
10. *How many contractors were involved into the process of construction?*
11. *How many workers took part in the construction?*
12. *What are the interesting facts about the Tower Bridge? Complete the following table.*

1977	
	The Tower Bridge was opened to the public for the first time.
1993	
	The Tower Bridge celebrates 35 years of welcoming visitors to its exhibition.

Post-listening

13. *Find any other information about the Tower Bridge and get ready to tell about it to your partner.*

3. THE NEW YORK CITY'S BROOKLYN BRIDGE (02:40)

Pre-listening

1. *What is a bridge?*
2. *Why do people build bridges?*
3. *What types of bridges do you know?*
4. *What are the main dimensions of a bridge?*
5. *Study the following words and phrases.*

   To span, capacity, vehicle, to cycle, to designate, landmark, inhabitant.

While-listening

Watch the video track and answer the following questions.

6. *Where is the bridge situated?*
7. *What type of bridge is it?*
8. *What is its span?*
9. *What river does it span?*
10. *What does it connect?*
11. *What is its capacity?*
12. *What do tourists like to do?*
13. *What can be found near the bridge?*
14. *When was it constructed?*
15. *When was the bridge designated to be a National Historic landmark?*
16. *How many people live in New York?*
17. *How many tourists visit New York each year?*
18. *How long has New York been the centre of commerce and finance?*
19. *Which site is recommended to visit if you plan to visit New York?*

Post-listening

20. *Which facts about the bridge did you find the most interesting? Do you know any other interesting facts about the bridge? Would you like to visit New York and have a chance to walk through the Brooklyn Bridge?*

4. TACOMA BRIDGE (04:06)

Pre-listening

1. *What is a bridge?*
2. *Why do people build bridges?*
3. *Who takes part in bridge construction?*
4. *Who is responsible for scientific and accurate calculations? Who is responsible for accurate technological process of construction?*
5. *Study the following words and phrases.*

   Girder, inevitable, to abandon, to perish.

While-listening

Watch the whole video quickly and answer the following question:

6. *What is shown in the track?*

Watch, listen, read, and answer the following questions.

00:00—00:26

7. *What are the dimensions of the Tacoma Bridge?*
8. *How long was it under construction?*
9. *How long was it used?*

00:27—00:42

10. *What were the girders made of?*
11. *How tall were the girders?*

00:43—02:43

12. *What is shown in this part?*
13. *When did the first vibration happen?*
14. *What was the wind speed?*
15. *Who went on the bridge to have a look what was happening?*
16. *Could the collapse be avoided?*

02:44—end

17. *Was the car empty when the collapse happened?*
18. *What happened to the remains of the bridge after the collapse?*

Post-listening

19. *Why do you think the collapse happened?*
20. *What should be done to avoid bridge collapses?*

5. THE BIGGEST SUSPENSION BRIDGE (04:30)

Pre-listening

1. *What is a bridge?*
2. *Why do people build bridges?*
3. *What types of bridges do you know?*
4. *Study the following words and phrases.*

   To span/spanning, to block, a rope, a deck, a chain, to suspend, to level, anchor, to blast, frame.

While-listening

Watch the video track **part by part** and answer the following questions.

00:00—00:19

5. *When did people begin thinking of travelling from Wales to Ireland?*
6. *What task was Tomas Telford given?*
7. *How old was Tomas Telford?*

00:20—00:34

8. *Fill in the gaps in the following text with the words you hear.*

For the (*1*) ___________ he arrived at man eye, Telford had a (*2*) ___________ as one of the finest (*3*) ___________ engineers in (*4*) ___________, be given this huge (*5*) ___________ to (*6*) ___________ the main coaching route between Britain and (*7*) ___________.

00:35—01:00

9. *What type of bridge was originally planned to be built?*
10. *Why did Telford give up the idea of an arch bridge?*

01:01—02:09

11. *What was used to travel across river in ancient times?*
12. *What are the people shown in the track?*
13. *What do they want to do?*

02:10—02:56

14. *What process is shown in this part*?
15. *What is the aim of towers*?
16. *What should the bridge towers be made of*?

03:05—03:48

17. *How long is the tunnel that was blasted in order to anchor chains of the bridge?*
18. *What is found at the end of the tunnel?*
19. *How long are the bolts that join the chains with the frame?*

03:49—end

20. *What did the new bridge help to do?*
21. *How long is the deck of the bridge?*
22. *How old is the bridge?*
23. *What is the capacity of the bridge?*

Post-listening

24. *Summarize the information of the track and be ready to tell about the bridge to your partner.*
25. *Make a small text about the process of construction of a suspension bridge.*

6. THE CLIFTON SUSPENSION BRIDGE 1 (05:00)

THE CLIFTON SUSPENSION BRIDGE 2 (05:00)

Pre-listening

1. *What is a “suspension” bridge?*
2. *Do you know where the Clifton Suspension Bridge is situated?*

While-listening

Watch the two video tracks (video 1 and video 2) and do the following assignments.

3. Are the following statements true (T) or false (F)?

1	The idea of the bridge appeared over 150 years ago.	T	F
2	The designer of the bridge was young.	T	F
3	The idea and the design of the bridge belonged to one and the same person.	T	F
4	The bridge was constructed in 1843.	T	F
5	The designer of the bridge liked it after the completion.	T	F
6	The tower of the bridge is the memorial to Brunel.	T	F
7	Over 30 years passed after the construction was finished.	T	F
8	Nobody was injured during the construction.	T	F
9	The capacity of the bridge is more than ten thousand vehicles a year.	T	F
10	Only one text gives information about the age of Brunel.	T	F
11	The bridge is still in use.	T	F
12	The construction of the bridge was stopped because of the Brunel's death.	T	F
13	Brunel's original design of the bridge was a little bit modified after his death.	T	F

4. Which text (1 or 2 or both) ...

1	gives information about the person who introduced the idea of construction?	
2	mentions the river that the bridge spans?	
3	mentions the place the bridge is located?	
4	gives information about the age of Brunel?	
5	gives the date of the beginning of the construction?	
6	mentions the organization which decided to make a memorial to Brunel?	
7	mentions animals?	
8	gives information about tragedies during the construction?	
9	gives information about capacity of the bridge?	

5. Complete the following table.

The Clifton Suspension Bridge

a	Name of a person who introduced the idea of the bridge construction	
b	The year of introduction of the idea of the bridge construction	
c	Name of the designer of the bridge	
d	Type of the bridge	
e	Place of construction	
f	River that the bridge spans	
g	Year of the beginning of the construction	
h	Year of the end of the construction	
i	Capacity of the bridge	

Post-listening

6. *Make a small text about the process of construction of a suspension bridge.*
7. *Summarize the information and be ready to speak about the Clifton Suspension Bridge.*

17. ANCIENT STRUCTURES

Part I

1. **Do you know the word "ancient"? What does it mean? What ancient structures built all over the world do you know? Read the following text and choose the best title (A, B, C).**

    A. Good jobs and good pay.
    B. Ancient engineering.
    C. The rulers of China and Egypt.

THE GREAT WALL OF CHINA was built across northern China to protect the **population**. Before the third century BC there were lots of smaller walls and these were joined together to make one long, **defensive** wall. The work was done by enormous gangs of forced **labourers** and many of them died doing the work. The wall is over 2,000 km long, 3.5 m high, and 4.5 m wide at the top. It is made of earth covered with stone.

THE EGYPTIAN PYRAMIDS are a famous symbol of ancient Egypt. The stone structures were usually **tombs** for pharaohs. The pyramids have square bases with sloping sides which meet at an **apex**. The first pyramid was built in about 2600 BC and is over 140 m high. One of the biggest pyramids is made of enormous stone blocks which weigh up to 200 tonnes each. It is estimated that 20–25,000 people worked for 20 years to build each pyramid.

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 21*, *pg. 24*, *Ex. 2.*)

2. Read the text again and find the English equivalents to the following expressions.

Для защиты населения; были соединены вместе; защитная стена; длиной более ... километров; высотой ... метров; шириной ... метров; это сделано из; знаменитый символ; каменные сооружения; квадратная основа; сходящиеся в вершине стороны; каменные блоки.

3. Use the information in the text to answer the questions below about the Great Wall of China and the first pyramid in Egypt.

		The Great Wall of China	The first pyramid in Egypt
1	Where is it?		
2	What is it?		
3	When was it built?		
4	What is it made of?		
5	Who built it?		
6	How big is it?		

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 21*, *pg. 24*, *Ex. 3.*)

4. Answer the following questions about the text.

1. What is the aim of a defensive wall?
2. What does the word "population" mean?
3. Who built enormous structures in ancient times?
4. What are the measurements of the Great Wall of China?
5. What are the pyramids?
6. What were the pyramids used for?
7. What are the pyramids made of?
8. How heavy are the stone blocks?
9. How long did it take to build one pyramid?

5. Read the text again and decide if the sentences below are true (T) or false (F).

1	The Great Wall of China was to keep people safe.	T	F
2	Building the Great Wall was easy for the workers.	T	F
3	The Pyramids were built before the Great Wall of China.	T	F
4	Pyramids are lots of different shapes.	T	F
5	The Egyptian pyramids were built to protect people.	T	F

("*Engineering*" *Workshop by Lindsey White*, *OUP*; *Unit 21*, *pg. 24*, *Ex. 4.*)

6. Match the words in bold type in the text with the definitions below.

1	A place where people are buried.	
2	The top or highest part of something.	
3	Protecting somebody against attack.	
4	People who do hard physical work outdoors.	
5	All the people who live in a country.	

(“*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 21*, *pg. 24*, *Ex. 5.*)

7. Give synonyms from the text to the following words.

Very, very old; to keep safe; to put together; well-known; very, very big.

8. Match the following words and make up as many word phrases as you can.

• stone • monument • building • civilization • equipment
• structure • famous • square • history • local • old • engineering
• well-known • tradition • pyramid • circle • metal • bridge • ancient
• young • female • wall • tower • triangle • position • modern

ancient	
defensive	
symbol	
structure	
base	
apex of a	
population	

9. Match the following words.

• wide • the population • base • engineering
• the Pyramid • sides • structure (×2) • of earth
• wall • blocks • safe • together • symbol

1	ancient		8	square	
2	to protect		9	sloping	
3	to join		10	apex of	
4	defensive		11	stone	
5	over 5 m		12	enormous	
6	famous		13	to keep	
7	stone		14	is made	

10. Complete the definitions with the words below.

• defensive • apex • enormous • base • labourer
• population • ancient • to protect

1	A person whose job involves hard physical work.	
2	To keep something safe, out of danger; to defend somebody.	
3	The lowest part of a building (or any other structure) on which it stands.	
4	It means "belonging to a period of history that is thousands of years in the past".	
5	The highest part of a building or any other structure.	
6	It means "very big or very great".	
7	It means "protecting something or somebody from attack".	
8	The number of people who live in a particular area, city, or country.	

11. Translate the following sentences into Russian. Translate the idea, not word for word.

1. Parents always protect their children from danger.
2. Safety equipment protects our body from damage.
3. A hard hat protects you when driving a bike.
4. Goggles protect our eyes while welding.
5. Soldiers took a defensive position.
6. Hard hat, goggles, and gloves are defensive means of safety.
7. How long is the defensive wall of China?
8. Warriors were standing on the top of a defensive wall.
9. What height is the apex of this Pyramid?
10. The apex of this construction is over 140 metres.
11. Sloping sides of a pyramid meet at an apex.
12. The apex of the tower of this bridge is the highest one.
13. The construction of the Pyramids involved manual labour.
14. A lot of labourers died during the construction of the Great Wall of China.
15. What is the population of your country?

16. The population of this country has increased for the last few years.
17. The population of China is enormous.
18. This building has a square base.
19. The Pyramids were built of stone blocks.
20. Stone blocks for building pyramids were very heavy.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Part II

1. ANCIENT CIVILIZATIONS AND THEIR ARCHITECTURE

Read the text and fill in the gaps with the following words.

• build • regional • mythology
• based • civilizations • design
• people • pyramids • functions • high

Ancient structures are products of ancient (*1*) ___________.

The Aztecs, people with a rich (*2*) ___________ and culture, dominated in central Mexico in the 14th, 15th, and 16th centuries. Their capital was Tenochtitlan on the shore of Lake Texcoco—the site of modern-day Mexico City. They were related to the preceding cultures in the basin of Mexico such as the culture of Teotihuacan whose building style they adopted and adapted.

The Maya are (*3*) ___________ of southern Mexico and northern Central America (Guatemala, Belize, western Honduras, and El Salvador) with some 3,000 years of history. Archaeological evidence shows the Maya started to (*4*) ___________ ceremonial architecture approximately 3,000 years ago. The earliest monuments consisted of simple burial mounds, the precursors to the spectacular stepped pyramids from the Terminal Pre-classic period and beyond. These pyramids were (*5*) ___________ on carved stone in order to create a stair-stepped (*6*) ___________. Many of these structures had a top platform upon which a smaller building was constructed, associated with a particular Maya deity (= a god). Maya pyramid-like structures were also constructed to serve as a place of interment (= burying of a dead body) for powerful rulers. Maya pyramidal structures had a great variety of forms and (*7*) ___________. That was the result of (*8*) ___________ and periodical differences.

La Danta temple is also the name of the largest Maya temple. The temple is 79 m (259 ft) (*9*) ___________, and with a volume of 2,800,000 cubic metres. It is one of the largest (*10*) ___________ in the world.

• located • structures • center • long • collapsed
• sides • astronomical • century • stone

The Tarascan state was a precolumbian culture that was (*11*) ___________ in the modern day Mexican state of Michoacán. The region is currently inhabited by the modern descendents of the P'urhépecha, normally spelled Purépecha in Spanish and in English. Tarascan architecture is noted for "T"-shaped step pyramids known as "yácatas".

The Teotihuacan civilization, which was developing from around 300 B.C. to 500 A.D., at its greatest extent included most of Mesoamerica. Teotihuacano culture (*12*) ___________ around 550 and was followed by several large city-states such as Xochicalco (whose inhabitants were probably of Matlatzinca ethnicity), Cholula (whose inhabitants were probably Oto-Manguean), and later the ceremonial site of Tula (which has traditionally been claimed to have been built by Toltecs but which now is thought to have been founded by the Huastec culture).

The Zapotecs were one of the earliest Mesoamerican cultures and held power over the Valley of Oaxaca region from the early first millennium BCE to about the 14th (*13*) ___________.

Altavista. This (*14*) ___________ and ceremonial center was the product of the Chalchihuite culture. Its occupation and development had a period of approximately 800 years (200–1000). This zone is considered an important archaeological (*15*) ___________ because of the astonishing, accurate functions of the structures. The most famous are: the Moon Plaza, the Votive Pyramid, the Ladder of Gamio, and the Labyrinth.

La Quemada. A lot of buildings were constructed on artificial terraces upon the sloping (*16*) ___________ of a hill. The materials used here include (*17*) ___________ blocks and clay. The most important (*18*) ___________ are: the Hall of Columns, the Ball Court, the Votive Pyramid, and the Palace and the Barracks. On the highest part of the hill is the Fortress. This is a small pyramid and a platform, with a wall around that is more than 800 m (*19*) ___________ and up to six feet high. La Quemada was occupied from 800 to 1200. Their founders and occupants have not been identified with certainty but probably belonged to the Chalchihuites culture or to the neighboring Malpaso culture.

2. ANCIENT STRUCTURES

Read the following text and fill in the gaps with suitable words.

Ancient (*1*) ___________ is everything that was built in ancient times by ancient (*2*) ___________ and is worthy of preservation and study due to archaeological or heritage interest. It could be buildings, (*3*) ___________, monuments, bridges, etc. The purposes of these structures were different. Some of the structures were (*4*) ___________ for living (buildings), some for (*5*) ___________ of the population (for example (*6*) ___________ walls around the towns), some for religion ceremonies (for example (*7*) ___________, cathedrals), etc. Usually a construction was built by (*8*) ___________, who often died during hard work. The main (*9*) ___________ for construction in ancient times were stone (*10*) ___________ and (*11*) ___________; later (*12*) ___________ and bricks appeared. This time was the time of ancient (*13*) ___________ where the design was based on (*14*) ___________ rather than on (*15*) ___________ and accurate calculations. But nevertheless, many of the structures were (*16*) ___________ enough and can be seen and even used in present.

If the task was too difficult for you, take the following words to fill in the gaps.

• labourers • cement • defensive • walls • blocks • pyramids
• scientific • structure • used • materials • engineering
• civilizations • protection • strong • earth • experience

Part III

(режим доступа для просмотра видеороликов http://englishtech.ru/video/modul_17/)

1. SEVEN WONDERS OF THE ANCIENT WORLD (02:45)

Pre-listening

1. *Can you make a list of the Seven Wonders of the ancient world?*
2. *Were they built BC or AD?*
3. *Do all of them still exist?*
4. *What could destroy them? (p.a.—time, rain, earthquake, fire, flood, etc.—natural disasters, people, war, etc.)*
5. *Study the following words and phrases.*

   BC/AD, earthquake, fire.

While-listening

Watch the whole video track and do the following assignments.

6. *Put the Seven Wonders of the ancient world in the order they appear in the track.*

Statue of Zeus at Olympia	
Colossus of Rhodes	
Great Pyramid of Giza	
Lighthouse of Alexandria	
Temple of Artemis at Ephesus	
Mausoleum of Halicarnassus	
Hanging Gardens of Babylon	

7. *Complete the following table. Fill in information about the builders of a wonder, time of construction, their present existence, cause of destruction.*

Wonder	Builders	Time of construction	Time of destruction	Cause of destruction
Great Pyramid of Giza				
Hanging Gardens of Babylon				
Temple of Artemis at Ephesus				
Statue of Zeus at Olympia				
Mausoleum of Halicarnassus				
Colossus of Rhodes				
Lighthouse of Alexandria				

Post-listening

8. *Choose any wonder from the list above and find additional information about it. Get ready to present it to your group.*

2. BUILDING THE GREAT WALL OF CHINA (03:22)

Pre-listening

1. *What kind of wall was it?*
2. *Why were such walls built?*
3. *What are the usual dimensions of an object?*
4. *Study the following words and phrases.*

   Dynasty, barbarian, to bake/backed, battlement, to curve, masterpiece, remains.

While-listening

Watch the video track **part by part** and answer the following questions.

00:00—01:20

5. *Which part of the Wall exactly is this video track about?*

6. *What name was it given?*
7. *When was it built?*
8. *Who was it intended to protect?*
9. *What is it made of?*
10. *How thick is it at its base?*
11. *What is the height of its battlements?*
12. *What is its length?*
13. *What is special in its construction?*
14. *How do visitors feel themselves at the sight of the Wall?*

01:25—01:57

15. *Fill in the gaps in the following text with the words you hear.*

But there is little doubt about the (*1*) ___________: "This is the frontier of our (*2*) ___________; on the other side the alien world (*3*) ___________." This (*4*) ___________ is the expression of a (*5*) ___________ that wanted to be entirely self-sufficient.

This stone (*6*) ___________ marks the pick of war (*7*) ___________ in China's long (*8*) ___________.

01:58—end

16. *How was the whole Great Wall of China built?*
17. *Was there any single strategic idea in its construction?*
18. *What was the length of all walls that were joined together?*
19. *Does the joined wall still exist?*
20. *What is the Great Wall symbol of?*

Post-listening

21. *Summarize information from the track to make a small text about the Great Wall of China.*
22. *Make a list of arguments for visiting the Great Wall of China.*

3. SECRETS OF STONEHENGE
(01:34)

Pre-listening

1. *What is Stonehenge?*
2. *Where is it situated?*

3. *Study the following words.*

   Arch, henge.

While-listening

Watch the video track and answer the following questions.

4. *Where exactly is the place shown in the video track?*
5. *What year is shown?*
6. *Why are the Pyramids in Egypt mentioned?*
7. *How heavy were the rocks?*
8. *How many people worked on this massive project?*
9. *How many arches are there in the centre of the circle?*
10. *Do we know for sure the real aim of this construction?*

Post-listening

11. *Would you like to visit Stonehenge? Why?*

4. STONEHENGE SECRETS (02:20)

Pre-listening

1. *What is Stonehenge?*
2. *Where is it situated?*
3. *What could its secret be?*
4. *Study the following words.*

   A ditch, to bury/burial, excavation, a clue, purpose.

While-listening

Watch the video track **part by part** and answer the following questions.

00:00—01:12

5. *What form does Stonehenge have?*
6. *When did the building begin?*
7. *What was it originally like at those times?*
8. *What was it probably constructed for?*
9. *When did the construction start again?*
10. *What is it made of?*

11. *How many blue stones were put there?*
12. *How much did each of those stones weigh?*
13. *How much time was it probably needed for this kind of job?*
14. *Why did the excavation begin?*

01:13—end

15. *When did the previous excavation take place?*
16. *How many professors work on this project?*
17. *What are the dimensions of excavation?*
18. *What are the scientists looking for?*
19. *A reporter from what organization takes part in this track?*

Post-listening

20. *Would you like to visit Stonehenge? Why?*

5. THE COLOSSEUM (ROME)
(01:15)

Pre-listening

1. *What is the Colosseum?*
2. *Where is it situated?*
3. *What was it used for in ancient times?*
4. *Study the following words.*

    Forum, queue, to relocate.

While-listening

Watch the video track and answer the following questions.

5. *What month is it?*
6. *What is the actual name of the Colosseum?*
7. *When was it built?*
8. *Where can people buy tickets to the Colosseum?*
9. *Which of these two ways of buying tickets is recommended and why?*
10. *Is the Colosseum situated on its original place?*

Post-listening

11. *What other ancient structures do you know in Italy (Europe)?*

6. A NEW DISCOVERY IN EGYPT (01:42)

Pre-listening

1. *What do you know about the Pyramids?*
2. *What is special about the Pyramids as one of the Seven Wonders of the ancient world?*
3. *Study the following words.*

   Excavation, remains, dynasty, chamber.

While-listening

Watch the video track **part by part** and answer the following questions.

00:00—00:16

1. *What is the main news?*
2. *When was it built?*
3. *What channel does the reporter work for?*

00:17—00:55

4. *What place exactly was it found in?*
5. *When was it found?*
6. *Where exactly is it located?*
7. *Which dynasty of pharaohs is mentioned in the track?*
8. *What is the height of this Pyramid now?*
9. *What was its original height?*
10. *Who is given a tour around the excavation site?*
11. *What was the aim of the Egyptian oldest Pyramid?*

00:56—end

12. *Who is being interviewed?*
13. *How long has the excavation lasted?*
14. *Who carried out this excavation?*
15. *How many Pyramids were rediscovered?*
16. *How many metres of sand have been removed?*
17. *When are archeologists going to enter the burial chamber?*
18. *What may happen to the content of the burial chamber if the archaeologists are late to enter it?*

Post-listening

19. Fill in the gaps in the following text using information from the track.

A new (*1*) ___________ was discovered (*2*) ___________ months ago in the (*3*) ___________ of Cairo near the famous ancient (*4*) ___________—Pyramid.

The Pyramid was built (*5*) ___________ years ago during the period of the (*6*) ___________ dynasty. It had been buried in the desert and was found as the result of (*7*) ___________ that has been held by the team of Egyptian (*8*) ___________ for the last (*9*) ___________ years. During the excavation (*10*) ___________ metres of sand was removed.

The Pyramid is 5 m (*11*) ___________, but originally it was about (*12*) ___________ metres. Now archaeologists are going to (*13*) ___________ the chamber within (*14*) ___________ weeks, otherwise everything can be (*15*) ___________ by thieves.

7. JOKE VAN DAELE AT PYRAMIDS (02:15)

Pre-listening

1. *What do you know about the Pyramids?*
2. *What is special about the Pyramids as one of the Seven Wonders of the ancient world?*
3. *Study the following words.*

   A sight, genius.

While-listening

Watch the video track and answer the following questions.

4. *What channel is broadcasting?*
5. *How many wonders of the world were mentioned except the Pyramids? What are they?*
6. *Who is being interviewed?*
7. *What are the Pyramids symbol of, as Mr Zahi Hawass thinks?*

8. *Why does the woman who is being interviewed think that the Pyramids are the real Wonder of the World?*
9. *How many tourists visit the Pyramids?*

Post-listening

10. *Try to persuade your partner to go on a tour to see the Pyramids.*

8. EGYPT GREAT PYRAMIDS (03:25)

Pre-listening

1. *What do you know about the Pyramids?*
2. *What is special about the Pyramids as one of the Seven Wonders of the ancient world?*
3. *Study the following words.*

   Pharaoh, survivor, acre, sarcophagus.

While-listening

Watch the video track **part by part** and answer the following questions.

00:00—01:26

4. *Which pyramid is exactly still in existence?*
5. *What area does this pyramid occupy?*
6. *How many labourers worked on the construction?*
7. *How long was the pyramid built?*
8. *How many stones were joined together?*
9. *What is its height?*
10. *How can you get to the chambers?*

01:27—02:11

11. *What was usually put into the stone sarcophagus?*
12. *Why was there a small hole in the wall of the chamber?*
13. *What were Egyptian pharaohs considered to be by ancient people of Egypt?*

02:12—end

14. *Why are camels shown*?

Post-listening

15. Look through the video tracks 6, 7 and 8 again. Are the following sentences about the Pyramids true (T) or false (F)?

1	Pharaohs were the Gods.	T	F
2	Pharaohs' souls stayed with the buried body forever.	T	F
3	There was nothing but a buried body of a pharaoh in a chamber.	T	F
4	The Pyramids were built as a burial ground for pharaohs.	T	F
5	It is easy to get to the chamber.	T	F
6	Camels are used by the Egyptians as a part of tourist business.	T	F

18. NUMBERS

(*The material of the module is taken from "Engineering" Workshop by Lindsey White, OUP; Unit 25, pg. 28; Unit 26; pg. 29.*)

1. Match the Arabic and Roman numbers.

• 40 • 500 • 1000 • 10 • 100 • 50 • 1 • 5 • 800 • 60
• M • I • D • C • L • LX • V • XL • X • DCCC

2. Which numbers are used in mathematics? Why?

3. Match the numbers below with the words in the table.

Note: In English, you write a point (**.**) not a comma (**,**) in decimal numbers. You say the numbers after the point separately, for example "23.34" is pronounced as "twenty-three point three four".

• $^1/_2$ • 1,000,000 • 2.5 • 327 • 2,580 • 0 • $^1/_4$ • $^2/_3$ • 3.6%

1	two thirds	
2	three point six per cent	
3	a quarter	
4	zero/nought	
5	two point five	
6	one million	
7	two thousand, five hundred and eighty	
8	three hundred and twenty-seven	
9	a half	

4. Read the text and fill in the gaps with the following words or number.

• half • –5° • –40° • 88% • hundreds
• 200 • 14,000 • 1989 • 4,000 • 5,000 m²

THE JUKKASJARVI ICEHOTEL

The Jukkasjarvi Icehotel in Sweden is an interesting and cold place for a holiday. It started life as an igloo (a small house made of snow) at an art exhibition in (*1*) ___________.

(*2*) ___________ of people visited the exhibition and some even slept there, so the builders decided to make it a hotel.

The Icehotel is open for less than (*3*) ___________ of the year. Every May it melts and every November it is rebuilt. It now measures (*4*) ___________ and it needs (*5*) ___________ tons of ice and 30,000 tons of snow to build it. This actually means that it is more than (*6*) ___________ snow.

The temperature inside the hotel is usually about (*7*) ___________.

Outside in Jukkasjarvi itself the temperature can be much lower even as low as (*8*) ___________!

Last year more than (*9*) ___________ visitors travelled (*10*) ___________ km north of the Arctic Circle to sleep in thermal sleeping bags. They got a cool reception!

5. Write the following numbers correctly.

1	thirty-four point five per cent	
2	six point nine seven	
3	one third	
4	four thousand five hundred and sixty-seven	
5	three thousand nine hundred and fifty-eight	
6	fifty-five per cent	
7	a half	
8	seven point six five	

6. Search the Internet and find the answers to the following questions.

(a) Who introduced Arabic numbers to European maths?
(b) Who developed the idea of "zero"?

7. Read the following text.

POPULATION IN THE UK

There were (*1*) *twelve point one million* children aged under (*2*) *sixteen* in (*3*) *two thousand*: (*4*) *six point two million* boys and (*5*) *five point nine million* girls. This is fewer than in (*6*) *nineteen seventy-one*, when there were (*7*) *fourteen point three million* children.

In (*8*) *two thousand*, (9) *thirty per cent* of children in the UK were under five, (*10*) *thirty-two per cent* were aged five to nine years and (*11*) *thirty-eight per cent* were aged ten to fifteen. These proportions were similar in the (*12*) *nineteen seventies*.

8. Choose the correct answers to the questions below.

1. Where is the text from?
   (a) A government information leaflet.
   (b) A teenage magazine.
2. What is the text about?
   (a) How many children watch TV in Britain.
   (b) How many children there are in Britain.
3. Who is this information useful for?
   (a) People planning educational resources.
   (b) Teachers and parents.

9. Read the text above again and write the numbers in italics from the text in figures.

1	12.1 m (12,100,000)	7	
2		8	
3		9	
4		10	
5		11	
6		12	

10. Read the text again and decide if the sentences below are true (T) or false (F).

1	There are more boys than girls in Britain.	T	F
2	The total number of children has increased since a census in 1971.	T	F
3	In 1971 the same percentage of children were under five.	T	F

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

19. SIGNS, SYMBOLS, AND ABBREVIATIONS

(*The material of the module is taken from "Engineering" Workshop by Lindsey White, OUP; Unit 23, pg. 26; Unit 24; pg. 27.*)

Section A

1. What do these abbreviations stand for? Match the abbreviations below with their full forms.

• cm • kg • l • ml • g • $(x)^2$ • $(x)^3$ • km • m

1	centimetre	
2	gram	
3	kilogram	
4	kilometre	
5	litre	

6	metre	
7	millilitre	
8	cubic	
9	square	

2. Do we have the same words in the Russian language? Why is it useful to have standard international systems?

3. Fill in gaps in the sentences below with the following words.

• area • capacity • distance • length • liquid (quantity) • speed • weight • height

DID YOU KNOW?

1. The ____________ of the Eiffel Tower in Paris is about *three hundred metres*.

2. The ___________ of the Charles Bridge in Prague is *five hundred and sixteen metres*.
3. The surface ___________ of Lake Balaton in Hungary is *five hundred and ninety-three square kilometres.*
4. The maximum ___________ limit on expressways in Poland is *one hundred and ten kilometres per hour.*
5. The ___________ of the bell in Dubrovnik's city tower is *two thousand kilograms*.
6. The ___________ between Bratislava and Budapest is about *two hundred kilometres*.
7. A magnum champagne bottle can hold *one point five litres* of ___________.
8. The engine ___________ of Formula One car is *three thousand cubic centimetres*.

4. Match the numbers and abbreviations below with the words in italics from Ex. 3.

• 516 m • 110 kph • 3,000 cc (or cm³) • 200 km
• 300 m • 1.5 l • 593 km² • 2,000 kg

1	height		5	weight	
2	length		6	distance	
3	area		7	liquid	
4	speed		8	capacity	

5. Rewrite the measurements below as numbers and abbreviations.

Note: In English, we say 5 m × 7 m as "five metres by seven (metres) " when we are talking about area. In mathematics, 5 × 7 is "five times seven" or "five multiplied by seven".

1	Twenty-two kilometres per hour	
2	Two litres	
3	One point five square metres	
4	Six square kilometres	
5	Fifty millilitres	
6	Eighteen kilograms	
7	One hundred and thirty grams	
8	One point five metres by fifty centimetres	
9	Nought point seven five cubic metres	

6. Write true answers to the following questions.

1. How large is your classroom?
2. How tall are you?
3. What is the speed limit on the roads in your country/city/town?
4. How fast can you run?
5. What is the area of your desk?
6. How much does your bag weigh?
7. How much did you weigh when you were born?
8. How far is it from Kazan to Moscow?

Section B

1. What are the following things? What have the words got in common?

• Biro • Braille • guillotine • Hoover
• Jacuzzi • Levis • Stetson

2. Put the following words (standard international units) into the correct column.

• amp • Celsius • curie • hertz • joule • kelvin
• newton • ohm • pascal • volt • watt

Chemistry (1 word)	**Electricity** (6 words)	**Physics** (2 words)	**Temperature** (2 words)

3. Complete the definitions below with the units from Ex. 2 and the people from the list.

• Andrè Marie Ampère (1775–1836) • Anders Celsius (1701–1744)
• Marie Curie (1867–1934) • Heinrich Hertz (1857–1894)
• James Prescott Joule (1818–1889) • Lord Kelvin (1824–1907)
• Georg Simon Ohm (1787–1854) • Blaise Pascal (1623–1662)
• Sir Isaac Newton (1643–1727) • Count Alessandro Volta (1745–1827)
• James Watt (1736–1819)

1. A ___________ is a unit of pressure equal to one Newton per square metre. It's named after ___________, a French scientist.

2. A ___________ is a unit of force. It's named after ___________, an English mathematician.
3. ___________ is the temperature scale that has the freezing point of water as 0°C and the boiling point as 100°C. The scale was developed by a Swedish astronomer, ___________.
4. A ___________ is an amount of electric power. It is equal to one joule per second. It's named after ___________, a Scottish engineer and inventor.
5. A ___________ is a unit of electric force. It's named after ___________, an Italian physicist and pioneer in the study of electricity.
6. An ___________ is a unit of electric current. It's named after ___________, a French mathematician and physicist, a pioneer in electrodynamics.
7. An ___________ is a unit of electrical resistance named after ___________, a German physicist.
8. A ___________ is a unit of energy named after ___________, a British physicist.
9. ___________ is the temperature scale that registers absolute zero (-273.15°C) as 0°K. It's named after ___________, a British scientist.
10. A ___________ is a frequency equal to one cycle per second. It's named after ___________, a German physicist.
11. A ___________ is a unit of radioactivity. It's named after ___________, a Polish-born chemist who discovered radioactivity in several elements.

4. Read the sentences from Ex. 3 again and find the words that mean.

1. a person who studies the elements and their compounds;
2. a person who studies the universe;
3. a person who studies the physical properties of materials;
4. a person who thinks of new machines;
5. a person who develops new ideas about a subject.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

20. JOB APPLICATION AND CV

(*The material of the module is taken from* “*Engineering*” *Workshop by Lindsey White*, *OUP*; *Unit 23*, *pg. 26*; *Unit 24*; *pg. 27.*)

Section A

1. **Read the texts (letter A and letter B) and choose the correct answers to questions below the texts.**

Letter A	(*1*) 28 High Avenue Harlow Essex CM 16 7AY (*2*) 01279 5743461
(*3*) Admission Secretary Stevenage Technical College West Road Stevenage Herts ST6 8PI (*4*) 30 April 2003 (*5*) Dear Sir/Madame, Please send me details of your foundation course in computer engineering. Yours faithfully, (*6*) Katy Evans	

Letter B	(*1*) Stevenage Technical College West Road Stevenage Herts ST6 8PI (*2*) 01438 7546392
(*3*) Ms K Evans 28 High Avenue Harlow Essex CM 16 7AY (*4*) 17 May 2003 (*5*) Dear Ms Evans, Thank you for your enquiry. I enclose the details that you requested and some additional information about the college's facilities. Please contact me if you require any further information. Yours sincerely, (*6*) Mrs LH Lee Admission Secretary	

1. Letter A is *to/from* Katy Evans.
2. *Mrs Lee/Katy Evans* works at the college.
3. Katy Evans *is/wants to be* a student at the college.
4. Katy Evans wants information about *a basic/an advanced* course.
5. Mrs Evans sends *exactly what/more than* Katy asked for.

2. Match the features (1–6) on each letter with the features (A–F) below.

A	The receiver's address	
B	The receiver's name	
C	The sender's address	
D	The sender's phone number	
E	The sender's name	
F	The date	

3. Read the messages. Are they formal (f) or informal (i)?

a	Please contact me to arrange another appointment.
b	I'll show you round...
c	Call me and we'll fix a time to meet.
d	I regret to inform you that your application has not been successful.
e	Please supply additional information about your experience.
f	cu@10
g	Tell me more about what you did.
h	I'd like to introduce you to...
i	There will be an opportunity to visit...
j	Bad luck about the job.
k	Your interview has been arranged for ten o'clock.
l	This is...

4. Match the formal and informal messages with the same general meaning (in Ex. 3).

5. Rewrite the following formal phrases in informal English.

Example: We'd be delighted if you could join us for drinks. → Let's go and drink together.

1. In response to your recent enquiry...
2. The receptionist will direct you to the correct room.
3. I look forward to hearing from you.
4. I hope that will be acceptable.

Section B

1. Read the curriculum vitae (CV) quickly and choose the correct answers to the questions below.

1. What is a CV?
   (a) A description of someone's family, education, likes, and dislikes.
   (b) A description of someone's education, work experience, and skills.
2. How is a CV arranged?
   (a) Under headings.
   (b) Like a letter.

NAME	Gavin H. Alvarez
ADDRESS	26 Dryfield Road, Cambridge, CB2 2DC
TELEPHONE NUMBER	01223 3268452
E-MAIL ADDRESS	gavinhalvarez@btinternet.com
DATE OF BIRTH	14 June 1984
EDUCATION	
1995–2000	Graves High School for Boys
Graves Avenue, Cambridge CB 4RG	
2000–2002	Cam College of Engineering and Technology
Birch Road, Cambridge CB6 7YT	
QUALIFICATIONS	
2000	GCSEs: English, Maths, General Science, Design and Technology, French, Spanish, Art, and History
2001	Level 1 Engineering and Technology foundation course
2002	Level 2 Computing course specializing in software development
WORK EXPERIENCE	
AUGUST—SEPTEMBER 2000	Temporary job as IT assistant at Norris's Aeronautics, Cambridge
OCTOBER 2000—JUNE 2007	Saturday and holiday job testing computer games at Silicompany, Cambridge
OTHER INFORMATION	Bilingual in Spanish and English. Clean driving licence
INTERESTS	Developing computer games, member of college football team, photography, and playing the guitar
REFEREE	Ms Daisy Valentine (course tutor). Cam College of Engineering and Technology. Birch Road, Cambridge CB6 7YT

2. Read the CV again and decide if the sentences below are true (T) or false (F).

1	Gavin Alvarez lives in Cambridge.	T	F
2	He is a student at Cam College.	T	F
3	He passed his GCSEs in 2001.	T	F
4	He has had Saturday and holiday jobs since 2000.	T	F
5	He left Cam College in 2000.	T	F
6	He is quite good at languages.	T	F
7	He isn't interested in technology.	T	F

3. Read the following advertisements. Which job is the best for Gavin?

(a) **GAMES4U** WANTS YOUNG, DYNAMIC PEOPLE TO DEVELOP THE NEXT GENERATION OF COMPUTER SOFTWARE. FOREIGN LANGUAGES AN ADVANTAGE. SEND CV AND COVERING LETTER TO...	(b) **BOOKS FOR STUDENTS** NEED TWO PEOPLE AGED 18–20 TO WORK IN THEIR ENGINEERING AND TECHNOLOGY DEPARTMENT. TO APPLY, SEND CV AND COVERING LETTER TO...

4. Read these phrases from the CV and the advertisements. Choose the correct meaning (a or b) of the words in *italics*.

1. ...a *covering* letter...
   (a) A letter to give more information.
   (b) A letter to hide a CV.
2. foreign languages an *advantage*...
   (a) It will help if you can speak a foreign language.
   (b) It is essential that you can speak a foreign language.
3. a *clean* driving licence...
   (a) Your licence isn't dirty.
   (b) You haven't done anything illegal in a car.

5. Write your own CV in English. Use Garvin's CV as a model for your writing.

Check the knowledge of active vocabulary from this module with the help of "ACTIVE VOCABULARY" section.

Test 1

(Modules 1–5)

I. Change the words in italics so that the sentence has a similar meaning; write the answer on the right.

1	Engineers solve problems in a "*step-by-step*" way.	
2	If you want to *make* your project *better*, you should work harder.	
3	You can finish your work *in the office*.	
4	Engineering can be *classified* into three main areas.	
5	People can *give and get information to each other* in different ways.	
6	You can talk to each other *out of the office*.	
7	At the beginning all students take a *beginner course* where they study general subjects.	
8	After finishing the beginner course students *focus on* one type of engineering.	
9	What sort of *knowledge and skills* do you need for the job?	
10	First of all you should get *basic* skills.	
11	How is your knowledge *evaluated* at the University?	
12	Do you work *all the day long*?	
13	I'm a new *trainee*. Who is my instructor?	
14	Have you *got good mark in* your exam?	
15	Please, Jane, ask a new trainee *some questions to evaluate his knowledge*.	

16	Brass is *a mixture* of copper and zinc.	
17	Usually implants are *pressed* and put into the patient's body.	
18	Glass is a *clear* light material.	
19	Copper *conducts* electricity well.	
20	What was your *first* plan?	

____/20

II. Guess the words from their explanations and write them on the right.

1	A person who designs, builds, maintains engines, machines, etc.	
2	Characteristic of a person; "a sort of a person". You must think of this before choosing your profession.	
3	A document that you get after you pass all exams and graduate from the University.	
4	A period of time (usually half a year) when students study before they take exams.	
5	A lesson of discussion and practical work when people communicate and show their knowledge.	
6	A person who works for low pay as an assistant of an experienced person in order to learn the skills for a particular job.	
7	A person who trains (teaches) people for some particular job.	
8	A degree, a diploma, a certificate; theoretical and practical knowledge; you need this to get a job.	
9	A type of job when you work for 8 hours a day and 5 days in a week. It is opposite to a part-time job.	
10	The process of getting marks for each project you do during the term.	
11	A room or a building (especially in the scientific institutions) that is used for scientific experiments or testing.	
12	The most important things to learn; basic knowledge of any subject that you need for your future study.	

13	To focus on one small part of a subject and to study it in details.	
14	To take an exam and to get a good mark.	
15	Process of asking-answering questions in order to get information about a person and his/her qualification.	
16	Ability of our brain to remember different things.	
17	Something medical that is put inside the patient's body.	
18	Mixture of two metals that is also known as "smart material".	
19	Ability of a person to create different pictures in mind.	
20	To make something smaller; to become smaller (about an implant).	

_____/20

III. Give your own explanations to the following words.

1	manufacturer	
2	to design	
3	building site	
4	engineering	
5	part-time job/course	
6	to specialize	
7	applicant	
8	environment	
9	plastic	
10	brass	

_____/10

IV. Match the words.

• electricity • exam • way • into • a problem
• for • shape • a technique • alloys • at • in
• job (activity) • body • form • solution • course
• imagination • fibre • price • system

1	solve		11	original	
2	practical		12	patient's	
3	use		13	carry	
4	reasonable		14	optical	
5	methodical		15	metal	
6	indoor		16	foundation	
7	computer		17	divide	
8	application		18	be interested	
9	take		19	apply	
10	human		20	be good	

____/20

V. Fill in the gaps with suitable words (from modules 1–5) and write the answers on the right.

1	Brass doesn't .... in contact with water.	
2	Implants .... to the temperature of a patient's body.	
3	Metals .... when they are heated.	
4	.... is the hardest natural material.	
5	.... is a material that can carry light and coded messages.	
6	During an exam a teacher wants to .... student's knowledge of the subject.	
7	Experience comes after	
8	Jane, you'll be an .... to this group of young trainees.	
9	The metal alloys are usually an expensive .... of titanium and nickel.	
10	What sort of .... do I need to get this job?	

____/10

VI. Answer any five questions you like. Give as much information as you can.

1. What is the process of solving a problem?
2. How many types of engineering are there? What are they?
3. Why is personality so important in choosing a profession?
4. What is a "smart material"?
5. Why are smart materials so important in our life?
6. Where do we use smart materials?
7. What is the process of choosing a course?
8. What are different things made of? Why?
9. What is the role of engineering today?
10. What is the process of study at the University?
11. What is the process of getting a job?
12. Why is interview so important in the process of getting a job?

_____/10

Total: _____/100

Test 2

(Modules 6–10)

I. Change the words in italics so that the sentence has a similar meaning; write the answer on the right.

1	In the context of technical drawing process computer gives a number of *benefits*.	
2	All *parts* of a car are joined together on an assembly line of a plant.	
3	The design of a new model of the car is *a real state of the art*.	
4	The *classical* "Mini" car is still very popular.	
5	A lot of *professional employees* work at the Morgan plant.	
6	This sign says there is a *danger* of being injured.	
7	The instructor must *monitor* the whole process of welding.	
8	If you want to have healthy eyes—keep the *display* at your eye-level or a little bit lower.	
9	Before you start working with a computer, you should *connect it to the main supply*.	
10	It is very important to use your body *correctly* in order to prevent RSI.	
11	Doing one and the same *action* can develop RSI.	
12	There are different ways to *minimize* the risk of RSI development.	

13	Don't forget about safety equipment while welding in order to *keep* your body *safe*.	
14	The first "Mini" was *produced* in 1959.	
15	Good working *environment* was suggested to the workers of the plant.	
16	Have you read all the *rules* on how to work with this kind of equipment?	
17	Please find *any other detailed* information about this event in history.	
18	*Modern types of* TVs, video cameras, photo cameras *with electric signals* help us save, change, recycle information, and also improve the quality of images.	
19	*Don't tighten* these screws! We need to change the cable.	
20	Please could you *switch* the television on?	

____/20

II. Guess the words from their explanations and write them on the right.

1	A person who designs buildings.	
2	The place on the factory where the cars are put together.	
3	Highly-skilled people, especially who make things by hand.	
4	An object, usually in a wall, that you put the plug into in order to connect electrical equipment to electrical supply.	
5	A kind of safety glasses to protect your eyes.	
6	You can see these things (objects) while driving along the road. All the drivers must know these things (objects).	
7	One of the five parts at the end of each hand.	
8	To remove the plug from electrical supply.	
9	The narrow part at the end of your arm where it joins your hand.	

10	"□"—what shape is this?	
11	To join together two or more electrical objects.	
12	Detailed information on how to do or use something.	
13	A computer system that helps people operate machines, engines at the factory.	
14	The modern kind of TVs, photo and video equipment.	
15	Art of representing objects by lines with a pencil.	
16	To do something with an object in order to use it again.	
17	To do something more than once.	
18	Correct in every detail, with no mistakes.	
19	Being the only one of its kind, very special and unusual.	
20	The place where the bones of your arm join and your arm bends.	

____/20

III. Give your own explanations to the following words.

1	advantage	
2	employee	
3	laptop	
4	gloves	
5	mouth	
6	foot	
7	knee	
8	handmade	
9	provider	
10	hand-drawn	

____/10

IV. Match the words.

• hands • mouse • the screws • suit • model • drawing • image • boots • environment • information • the head • by hand • chair • board • designed • craftsmen • breaks • feeling • defenders • rules

1	technical		11	integrated	
2	working		12	drawing	
3	ergonomically		13	turn	
4	boiler		14	ear	
5	basic		15	prototype	
6	shake		16	safety	
7	loss of		17	highly-skilled	
8	loosen		18	adjustable	
9	regular		19	background	
10	draw		20	symmetrical	

_____/20

V. Fill in the gaps with suitable words (from modules 6–10) and write the answers on the right.

1	Loss of feeling, pain, and burning in the area—are the main .... of RSI.	
2	It is much easier to .... the illness than to cure it.	
3	Always read the .... before you start doing the task!	
4	If you are a welder, don't forget to wear all necessary .... equipment.	
5	You have much experience and that is your .... over other applicants.	
6	If you want to work as an engineer, you should get .... qualification.	
7	Drawing board, pencil, paper, set square—are all pieces of basic drawing	
8	The group of young engineers has ......a clear solution.	
9	Some chemicals are very ...., so put on safety gloves on your hands.	

10	When you work on the computer, you should keep your shoulders down, neck straight, and your back	

____/10

VI. Answer any one question (a, b, c or d) from each group (1–5). Give as much information as you can.

1a What are “CNC”, “CAD”? Where are they used? What are they used for?
1b What is the role of a computer in the process of technical drawing?
1c What is the difference in the process of technical drawing in the past and nowadays?
1d What are the advantages of computer-made drawings?

2a What are the advantages of using an assembly line in a car production process?
2b What do you know about the *Mini* car?
2c What do you know about the Morgan car?
2d Why are the *Mini* and the Morgan cars so famous?

3a Speak about the process of connecting all parts of a computer.
3b What is the difference between a computer and a laptop?
3c What are the parts of a computer?
3d Give instructions on how to connect a photo camera to a computer (a DVD to a TV).

4a What are the pieces of safety equipment?
4b Why do people need safety equipment?
4c What safety equipment does a welder need?
4d Comment on the signs in your additional handout.

5a What is RSI? Who is at the most risk of RSI?
5b What should people do to prevent RSI?
5c Give detailed instructions on how to use a computer in order to prevent RSI.
5d What are the symptoms of RSI?

____/10

Total: ____/100

Test 3

(Modules 11–17)

I. Change the words in *italics* so that the sentence has a similar meaning; write the answers on the right.

1	This equipment *costs much money*.	
2	Cars on assembly line are made by *machines*.	
3	Many bridges in St Petersburg *can open to allow boats go through*.	
4	RSI development can *harm* your health.	
5	Suddenly the construction *broke down*.	
6	Engineers formed a *special group of people* to solve this problem.	
7	Pyramids are *very, very old* constructions.	
8	Nowadays old-fashioned *ducts* are replaced by new ones.	
9	A Russian scientist A. Popov was the *first person* who made a radio.	
10	*Long heavy pieces of iron or steel* are normally used in bridge (or building) construction.	
11	This material *ignites easily*.	
12	People usually send *small texts* to each other with the help of mobiles or computers and this is the way they communicate.	
13	You must *join* these two plastic pieces *together* accurately.	
14	Safety equipment *defends* our body from damage.	

15	Each boss should know how to *control* employees.	
16	Each pack *has* 10 batteries *inside.*	
17	TBM is a *very, very big* machine.	
18	The manufacture wasn't *supplied* with necessary equipment in time.	
19	Your order will be *brought* within five days.	
20	He has got into an accident and there was a temporary loss of *vision*.	

_____/20

II. Guess the words from their explanations and write them on the right.

1	Material used to carry light and coded messages.	
2	A machine that produces electricity or converts power.	
3	A line across a circle.	
4	The space between two places or things.	
5	A device that can react to light, heat, pressure.	
6	The measurement from the bottom to the top.	
7	Facts or details about something.	
8	A machine that works automatically or is controlled by a computer.	
9	The number of people who live in a particular area, city, country, etc.	
10	Special things that you need to do something.	
11	A structure that carries a road or railway across a river.	
12	A clear hard material used for bottles, windows, etc.	
13	The top or the highest part of something.	
14	To move earth and make a hole in the ground.	

15	To break into peaces suddenly.	
16	People who work at a plant, manufacture, or for a company.	
17	Careful examination of different parts or details of something.	
18	Ability to be very active or do a lot of work without getting tired.	
19	The length of something from one end to the other, the synonym to “distance”.	
20	Something which transports people or things from place to place (cars, buses, bicycles, etc.)	

_____/20

III. Give your own explanations to the following words.

1	canal	
2	delivery	
3	enormous	
4	dam	
5	inventor	
6	generation	
7	pipeline	
8	solar energy	
9	gadget	
10	labourer	

_____/10

IV. Match the words.

• heating • bandwidth • sides • robots • atmosphere
• splicing • power • calculation • interference • the signal
• equipment • bridge • signal • material • device • energy
• safe • -friendly • information • technology

1	slopping		11	radioactive	
2	expensive		12	accurate	
3	to deliver		13	to store	
4	measurement		14	movable	
5	high		15	mechanical	
6	electromag- netic		16	solar	
7	radio		17	environmen- tally	
8	flammable		18	the wind-up	
9	electrical		19	industrial	
10	central		20	to keep	

____/20

V. Fill in the gaps and write the answers on the right.

1	We need a .... to convert mechanical power to electrical energy.	
2	Sensors of a robot usually send .... to a computer system.	
3	The ...... of this construction is over 140 metres.	
4	Radio was the greatest .... of the 19th century.	
5	The Pyramids are very .... structures. They were built many centuries ago.	
6	Mechanical .... are widely used in industry.	
7	Computer system gives .... to robots.	
8	Be careful with this materials, they can ignite easily. In other words they are very	
9	Electrical, solar, kinetic—are different types of	
10	Tin opener, MP3-player, thermometer, etc., are small .... which we usually use in our everyday life.	

____/10

VI. Answer any five questions you like. Give as much information as you can.

1. What is optical fibre? What are its characteristics?
2. What are the advantages and disadvantages of optical fibres?
3. How are tunnels made? What are tunnels made for?
4. What types of energy do you know?
5. What is the idea of a wind-up technology?
6. What is a robot? What is its role in people's life?
7. What are the differences between people and robots?
8. What is a gadget? What is its role in people's life?
9. What types of bridges do you know?
10. What were the principles of bridge construction in the past? What are they now?
11. What are the dimensions of a bridge?
12. What ancient structures do you know? What is special about them? How were they built?

____/10

Total: ____/100

Exam materials
(Экзаменационные материалы)

Экзамен сдается после прохождения всех модулей курса. Экзаменационные материалы находятся у преподавателя. Всего десять билетов. В каждом билете — шесть видов заданий, повторяющих по своему формату задания в тестах.

Максимальное количество баллов за экзамен — 50.

Методика оценивания ответа на экзамене:

51–70% (25,5—35 баллов) — «3»;

71–85% (35,5—42,5 баллов) — «4»;

86–100% (43—50 баллов) — «5».

Active vocabulary
(Список активной лексики)

sth = something
sb = somebody

Module No.	Word/phrase	Similar meaning	Opposite meaning
1	**Engineering in Our Life**		
	communication		
	engine		
	engineer		
	engineering		
	manufacture	plant, factory	
	manufacturer	producer	
	methodical way	step-by-step technology	
	practical solution		
	reasonable price		
	solution	answer	
	technique	way	
	to communicate		
	to define the problem		
	to design a solution		
	to evaluate the solution		
	to find a solution		
	to produce practical answer		
	to test the solution		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
2	**Types of Engineering**		
	area	part, field	
	building site		
	civil engineering		
	electrical engineering		
	indoors		outdoors
	mechanical engineering		
	outdoors		indoors
	personality	sort of person	
	science		
	type of sth	kind of sth	
	to be divided into	to be classified	
	to be interested in		
	to cover (a problem)		
	to divide into	to classify	
	to improve	to make sth better	
3	**Making the Right Choice**		
	applicant		
	application form		
	apprentice	trainee, assistant	trainer, instructor
	assistant	trainee, apprentice	trainer, instructor
	basic skills	key skills	
	beginner course	foundation course	
	CAD		
	certificate		
	communication		
	continuous assessment		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	diploma		
	education		
	experience		
	fitting		
	foundation course	beginner course	
	full-time		part-time
	instructor	trainer	trainee, apprentice, assistant
	interview		
	key skills	basic skills	
	laboratory		
	level		
	part-time		full-time
	practical seminar	workshop	
	practical skills		
	qualification		
	term		
	theoretical knowledge		
	trainee	apprentice, assistant	trainer, instructor
	trainer	instructor	trainee, apprentice, assistant
	welder		
	welding		
	workshop	practical seminar	
	to apply for		
	to assess	to evaluate, to mark	
	to be assessed	to be marked	
	to be good at		
	to be suitable for		
	to evaluate	to assess, to mark	
	to fill in a form		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	to focus on	to specialize in	
	to pass exam		to fail exam
	to prepare for		
	to specialize in	to focus on	
	to take exam		
4	**Materials and Their Properties**		
	aluminium		
	asphalt		
	brass		
	breaks easily		tough
	brick		
	building blocks		
	cardboard		
	cement		
	clear	transparent	opaque
	coded messages		
	copper		
	diamond		
	easy to shape		rigid
	easy to shape / break / cut, etc.		
	electrical wire		
	glass		
	hard		soft
	heavy		light
	iron		
	light		heavy
	metal		
	mild steel		
	natural material		
	nylon		
	opaque		clear, transparent
	optical fibre		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	plastic		
	rigid		easy to shape
	soft		hard
	strong		weak
	tough		breaks easily
	transparent	clear	opaque
	weak		strong
	wire		
	zinc		
	to be made of		
	to be used for		
	to carry electricity / light	to conduct electricity / light	
	to cut		
	to hold bricks together		
	to mix (with)		
	to rust		
5	**Smart Materials**		
	alloy		
	changes in the environment		
	environment		
	human imagination		
	implant		
	invention		
	memory		
	mixture		
	original shape		
	patient's body		
	possible uses		
	shape memory materials		
	to be put inside sth		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	to compress	to press	
	to expand	to become larger / to make sth larger	to contract / to compress
	to press	to compress	
	to react		
	to react to sth		
6	**Technical Drawing**		
	2D image / 3D image		
	accurate		
	advantage		disadvantage
	architect		
	component	part	
	consistent		
	diagram		
	disadvantage		advantage
	drawing		
	drawing board		
	drawing equipment		
	equipment		
	experiment		
	hand-drawn		
	image		
	part	component	
	ruler		
	set square		
	standard parts		
	symmetrical images		
	technical information		
	viewer		
	to be drawn by hand		
	to change		
	to experiment		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	to provide		
	to recycle		
	to save		
	to work at		
7	**Industrial Production**		
	advantage	benefit	drawback / disadvantage
	assembly line		
	background		
	background information		
	benefit	advantage	drawback / disadvantage
	CAM system		
	cheap		expensive
	CNC system		
	comfortable (for)		
	craftsman		
	dangerous		safe
	digital	numerical	
	employee		
	ergonomically designed		
	error	mistake	
	expensive		cheap
	factory	plant	
	fuel consumption		
	highly-skilled		
	human error		
	instruction	rule	
	model		
	modern	up-to-date	old-fashioned
	numerical	digital	

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	old-fashioned		modern, up-to-date
	operator		
	plant	factory	
	production system		
	prototype model		
	purpose of sth		
	rule	instruction	
	safe		dangerous
	state-of-the-art		
	traditional		
	unique		
	up-to-date	modern	old-fashioned
	working conditions	working environment	
	working environment	working conditions	
	to be designed / manufactured		
	to be easy to use		to be difficult to use
	to be made / produced		
	to complete		
	to lower		
	to mean		
	to own		
	to raise		
	to reduce	to minimize	
	to replace		
	to require		
	to spend		
	to turn through ... degrees		
8	**Electrical Equipment**		
	aerial		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	cable		
	central unit		
	computer		
	display	screen, monitor	
	input		output
	keyboard		
	mains		
	monitor	screen, display	
	mouse		
	output		input
	plug (*n*)		
	printer		
	screen	monitor, display	
	screw(s)		
	socket		
	speaker(s)		
	special scart		
	to connect		to disconnect
	to disconnect		to connect
	to insert	to put into	
	to loosen		to tighten
	to plug		to unplug
	to plug in		to plug out
	to plug out		to plug in
	to switch on		to switch off
	to switch off		to switch on
	to tighten		to loosen
	to unplug		to plug
9	**Safety Equipment**		
	Beware!		
	boiler suit		
	circle		
	corrosive		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	danger		
	dangerous		safe
	diagonal line		
	ear defenders		
	explosive		
	flammable		
	gloves		
	goggles		
	hard hat		
	instruction		
	mask		
	safety boots		
	sign		
	square		
	toxic		
	triangle		
	warning		
	to beware of		
	to forbid		
	to protect		
	to warn		
10	**Professional Diseases**		
	adjustable chair		
	advice		
	at … degrees		
	at eye level		
	basic rules		
	burning in the area		
	damaged area		
	difficulty in moving		
	high risk		
	injury		
	loss of feeling		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	lower position		upper position
	movement	action	
	RSI		
	straight		
	strain	tension	
	symptoms		
	tension	strain	
	upper position		lower position
	to be at the most risk		
	to be relaxed		to be strained / stressed
	to cure		
	to develop		
	to injure	to damage / to harm	
	to keep sth (flat, straight, etc.)		
	to move about	to go around	
	to prevent		
	to relax		to get stressed
	to repeat		
	to sit/move correctly		
	to take regular breaks		
	to use body naturally		
11	**Optical Fibres**		
	(high) bandwidth		
	(in) diameter		
	capacity		
	channel		
	copper cable		
	delivery		
	distance		
	duct	tube, pipe	

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	handler		
	ignition		
	measurement		
	micrometre		
	optical fibres		
	per metre/kg/hour, etc.		
	pipe	duct, tube	
	pipeline		
	splicing		
	transmission distance		
	tube	duct, pipe	
	use of sth		
	wave		
	wire		
	to be used safely		
	to carry signal(s)	to deliver signal(s)	
	to damage	to injure / to harm	
	to deliver signal(s)	to carry signal(s)	
	to handle	to touch	
	to harm	to damage / to injure	
	to ignite		
	to join		
	to splice	to join together	
	to use safely		
12	**Tunnels, Dams and Canals (Channels)**		
	across		
	around		
	between		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	canal (channel)		
	dam		
	enormous	huge	
	group	team	
	huge	enormous	
	opposite sides		
	over		
	passenger		
	seabed		
	specially-designed		
	team	group	
	through		
	tunnel		
	Tunnel Boring Machine (TBM)		
	under		
	vehicle		
	to be built by...		
	to dig		
	to go through		
13	**Scientific Inventions**		
	battery power		
	central heating		
	electrical energy		
	electricity		
	energy		
	environmentally-friendly		
	generation		
	generator		
	heating		
	inventor		
	kinetic energy		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	light		
	power		
	reliable		unreliable
	solar energy		
	type of sth		
	wind-up technology		
	to be perfect for		
	to be used in sth / for sth		
	to convert sth into sth		
	to develop		
	to drive a generator		
	to heat		
	to invent		
	to power		
	to store		
	to win an award		
	to wind up (spring)		
14	**Robots in Our Life**		
	device		
	hearing		
	mechanical		
	message		
	robot		
	robotics		
	routine work		
	sense		
	sensor		
	sight	vision	
	signal		
	smell		
	taste		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	touch		
	vision	sight	
	to be designed for/to		
	to behave like...		
	to react to...		
15	**Gadgets**		
	frame		
	gadget	device	
	helpful	useful	useless
	lens		
	prism		
	sight	vision	
	vinyl		
	vision	sight	
	to be (not) provided	to be (not) sup-plied	
	to be (not) supplied	to be (not) pro-vided	
	to be perfect for	to be ideal for	
	to contain		
	to deflect vision by ... degrees		
	to enjoy		
	to include		
	to look good/bad, etc.		
	to provide	to supply	
	to supply	to provide	
16	**Bridges**		
	accident		
	accurate calculations		
	analysis		
	bridge		
	definitely		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	detailed structural analysis		
	dimension (2D/3D)		
	disaster		
	enquiry		
	experience		
	fixed bridge		
	girder		
	height		
	length		
	moveable bridge		
	scientific		
	span		
	substandard		
	suspension bridge		
	tower		
	vehicle		
	to be built by ...		
	to be based on ...		
	to built	to construct	to break/destroy
	to collapse		
	to confirm		
	to construct	to built	to break/destroy
	to crack		
	to crash		
	to damage	to harm / to injure	
	to fix		
	to injure	to harm / to damage	
	to lift		
17	**Ancient Structures**		
	ancient		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	apex		
	base		
	defensive		
	famous symbol		
	enormous	huge	
	huge	enormous	
	labour		
	labourer		
	population		
	slopping sides		
	stone		
	stone blocks		
	to protect	to keep safe	
	to defend	to keep safe	
	to keep safe	to protect / to defend	
	structure		
	tomb		
	to protect	to keep safe / to defend	
18–19	**Numbers. Signs, Symbols, and Abbreviations**		
	abbreviation		
	amp		
	Arabic numbers		
	area		
	astronomer		
	bar chart		
	capacity		
	Celsius		
	centimetre		
	chemist		
	comma		
	curie		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	decimal numbers		
	distance		
	gram		
	height		
	hertz		
	hundreds		
	inventor		
	joule		
	kelvin		
	kilogram		
	kilometre		
	length		
	limit		
	liquid		
	litre		
	metre		
	millilitre		
	newton		
	nought		
	ohm		
	pascal		
	per hour/kg/metre, etc.		
	physicist		
	pie chart		
	point		
	Roman numbers		
	speed		
	standard international system		
	volt		
	watt		

Продолжение

Module No.	Word/phrase	Similar meaning	Opposite meaning
	weight		
	to do a survey		
	to label		
	to multiply		
20	**Job Application and CV**		
	additional information		
	address		
	advertisement		
	assistant		
	bilingual		
	covering letter		
	CV (curriculum vitae)		
	date (of birth)		
	description		
	driving licence		
	education		
	E-mail address		
	enquiry		
	formal letters		
	further information		
	I look forward to hearing from you		
	informal letters		
	letter from		
	letter to		
	qualification		
	receiver’s address		
	receiver’s name		
	referee		
	sender’s address		
	sender’s name		

Окончание

Module No.	Word/phrase	Similar meaning	Opposite meaning
	technician		
	temporary job		
	work experience		
	yours faithfully		
	yours sincerely		
	to contact sb		
	to enclose (details)		
	to require		
	to response to…		
	to send		

GLOSSARY
(Словарь)

(the glossary is taken from: *"Engineering" Workshop by Lindsey White*, *OUP*; *2003*, *pg. 34–39.*)

Abbreviations

abbr — abbreviation	*prep* — preposition
adj — adjective	*sb* — somebody
adv — adverb	*sing* — singular
C — countable	*sth* — something
n — noun	U — uncountable
pl — plural	*v* — verb

A

absolute zero *n* [U] the lowest temperature possible (-273.15°C)
accurate *adj* exact and correct
across *adv*, *prep* from one side of sth to the other
adjustable *adj* that can be moved into different shapes or positions
advantage *n* **1.** [C] sth that may help you to do better than other people; **2.** [C, U] sth that helps you or that will bring you a good result
aerial *n* [C] a long metal stick that receives radio or television signals
aeronautical *adj* connected with aircraft
aeroplane *n* [C] a vehicle with wings and engines that caп fly
alloy *n* [C, U] a metal formed by mixing two metals together, or by mixing metal with another substance
aluminium *n* [U] a light silver-coloured metal
amp *n* [C] (*abbr* **A**) a unit for measuring electrical current

analysis *n* [C, U] careful examination
antenna *n* (US) = aerial
apex *n* [usually *sing*] the top or highest part of sth
applicant *n* [C] a person who makes a formal request for sth (**applies for sth**), especially a job, a place at a college, university, etc.; **application** *n* [C, U]; **apply** *v*
appointment *n* [C, U] an arrangement to see sb at a particular time
apprentice *n* [C] a person who works for low pay in order to learn the skills needed in a particular job
architect *n* [C] a person who designs buildings
architecture *n* [U] **1.** the study of designing and making buildings; **2.** the style or design of buildings
area *n* [C, U] the size of a surface
around *adv*, *prep* on all sides; forming a circle
asphalt *n* [U] a thick black substance that is used for making the surface of roads
assembly line *n* [C] a line of people and machines in a factory that fit the parts of sth together in a fixed order
automatic *adj* (*used about a machine*) that can work by itself without direct human control; **automatically** *adv*
automobile *adj* connected with cars and the manufacture of cars

B

bandwidth *n* [C, U] a measurement of the amount of information that a particular computer network or Internet connection can send in a particular time
bar chart *n* [C] a diagram that uses narrow bands of different heights to show different amounts
bascule bridge *n* [C] a type of bridge with a section that can be lifted up
base sth on sth *phrasal v* to form or develop sth from a particular starting point or source
battery *n* [C] a device which produces electricity
benefit *n* [C, U] an advantage or useful effect that sth has
beware *v* **(of sb/sth)** (*used for giving a warning*) = be careful
Biro™ *n* [C] a type of pen
boiling point *n* [C] the temperature at which liquid starts to boil
bore *v* to make a long deep hole in sth with a tool

boring *adj* not at all interesting; dull
bottom *n* [C, usually *sing*] the lowest part of sth
brass *n* [U] a hard yellow metal that is a mixture of copper and zinc
break *v* to separate into pieces
bridge *n* [C] a structure that carries a road or railway across a river, valley, road, or railway
build *v* to make sth by putting pieces, materials, etc., together

C

cable *n* [C, U] a set of wires covered with plastic, etc., for carrying electricity or signals
cabling *n* [U] all the cables that are required for a particular piece of equipment or a particular system
calculation *n* [C, U] finding an answer using mathematics
CAM *abbr*: **computer-aided manufacturing**; the use of computers to control industrial processes
canal *n* [C] an artificial waterway made through land so that boats or ships can travel along it
capacity *n* [*sing*, U] the amount that a container or space can hold
cardboard *n* [U] very thick paper that is used for making boxes, etc.
casing *n* [C, U] a covering that protects sth
Celsius *adj* (*abbr* **C**) of or using a scale of temperature in which water freezes at 0° and boils at 100°
cement *n* [U] a grey powder that becomes hard after it is mixed with water and left to dry
census *n* [C] an official count of the population
centimetre *n* [C] (*abbr* **cm**) one hundredth of a metre
centre *n* [C] (usually *sing*) the middle point or part of sth
certificate *n* [C] an official piece of paper that says that sth is true or correct
chemical engineering *n* [U] the study of the design and use of machines in industrial chemical processes; **chemical engineer** *n* [C]
chemist *n* [C] a specialist in chemistry
chemistry *n* [U] the scientific study of the structure of substances and what happens to them in different conditions or when mixed with each other
civil engineering *n* [U] the design, building, and repair of roads, bridges, canals, etc.; the study of this as a subject

classic *adj* important and having a value that will last
clean *adj* **1.** not dirty; **2.** not showing or having any record of doing sth that is against the law: **a clean driving licence**
clear *adj* easy to see through (*opposite*: **opaque**)
clockwork *n* [U] a type of machinery that you operate by turning a key which winds up a spring and produces energy
CNC *abbr*: **computer numerical control**; the use of digital computer techniques to control a manufacturing process, especially the machines and tools involved in this process
collapse *v* to fall down or break into pieces suddenly
column *n* [C] a tall solid vertical post that supports or decorates a building
combine *v* to join or mix
communications *n* [U, also *pl*] methods of sending information, especially telephones, radio, computers, etc., or roads and railways
component *n* [C] one of several parts of which sth is made
compound *n* [C] sth that consists of substances combined together
compress *v* to make sth fill less space than usual
compressed-air *adj* using air under pressure as energy to drive machines and tools
computer *n* [C] an electronic machine that can store, find, and arrange information, calculate amounts and control other machines
connect *v* to join
consistent *adj* always having the same opinions, standard, behaviour, etc.; not changing
construction *n* [U] the act or method of making sth or building sth
contact *n* [U] **(with sth)** the state of touching sth
continuous assessment *n* [U] a system of giving a student a final mark based on work done during a course of study rather than on one exam
contract *v* to become or to make sth smaller or shorter
convert *v* to change sth from one form, system, or use to another
cool *adj* (*slang*) very good or fashionable
copper *n* [U] a common reddish-brown metal
corner *n* [C] a place where two lines, edges, surfaces, or roads meet
corrosive *adj* tending to destroy sth slowly by chemical action
course *n* [C] a complete series of lessons or studies

covering letter *n* [C] a letter containing extra information
crack *v* to break or to make sth break so that a line appears on the surface, without breaking into pieces
craftsman *n* [C] a person who makes things skilfully, especially with his/her hands
cubic *adj* (*abbr* **cu**) used to show a measurement of volume (= height × × length × width)
cure *v* to make sb healthy again after an illness
curie *n* [C] (*abbr* **Ci**) a unit for measuring radioactivity
curriculum vitae *n* [C] (*abbr* **CV**) a written record of your education and employment
cycle *n* [C] the fact of a series of events being repeated many times, always in the same order

D

dam *v* to build a wall across a river to hold back the water
decimal *n* [C] a number less than one
decimal point *n* [C] a dot or point used to separate a whole number from the tenths, hundredths, etc., of a decimal (for example in 0.61)
defensive *adj* that protects sb/sth from attack
define *v* to explain the exact nature or meaning of sth clearly
deflect *v* to change direction after hitting sb/sth; to make sth change direction in this way
degree *n* [C] a measurement of angles
deliver *v* to take sth to the place requested
description *n* [C] a picture of sb/sth in words
design *v* **1.** to plan and make a drawing of how sth will be made; **2.** to invent, plan, and develop sth for a particular purpose; **design** *n* [C]
designer *n* [C] a person whose job is to make drawings or plans showing how sth will be made
desktop *n* [C] a computer screen on which you can see symbols (icons) showing the programs, information, etc., that are available
detail *n* [C, U] one fact or piece of information
develop *v* **1.** to grow slowly, increase or change into sth else; to make sth do this; **2.** to think of or produce a new idea, product, etc., and make it successful; **3.** to begin to have a problem or disease; to start to affect sb/sth; **development** *n* [U, C]

developer *n* [C] a person or company that designs and creates new products

device *n* [C] a tool or piece of equipment

diagonal *adj* (*used about a straight line*) joining two opposite sides of sth at an angle that is not 90° or vertical or horizontal

diagram *n* [C] a simple picture that is used to explain how sth works or what sth looks like

diameter *n* [C] a straight line that goes from one side to the other of a circle, passing through the centre

diamond *n* [C, U] a hard, bright, precious stone

difficult *adj* not easy to do or understand

dimension *n* [C, U] a measurement in space, for example, the length, width, or height of sth; **dimensional** (*used to form compound adjectives*) having the number of dimensions mentioned

diploma *n* [C] (**in sth**) a certificate for completing a course of study

disadvantage *n* [C] sth that is not good or that causes problems

disaster *n* [C] an event that causes a lot of harm or damage

disconnect *v* **1.** to stop a supply of electricity, etc., going to a piece of equipment or a building; **2.** to separate sth from sth else

disposal *n* [U] the act of getting rid of sth

distance *n* [C, U] the space between two places or things

divide verb (**sth into sth**) to separate (sth) into different parts

drawing board *n* [C] a board used for holding a piece of paper while a drawing or plan is being made

driving licence *n* [C] a certificate that proves you have taken a test and are able to drive a car, etc.

duct *n* [C] a tube for carrying liquid, gas, electric, or telephone wires

E

ear defenders *n* [*pl*] pieces of soft material that you put over your ears to keep out noise

earphones *n* [*pl*] a piece of equipment that fits over or in the ears and is used for listening to music, the radio, etc.

easy *adj* not difficult; **easily** *adv*

efficiently *adv* well and thoroughly with no waste of time, money, or energy

electrical *adj* of or about electricity

electrical engineering *n* [U] the design and building of machines and systems that use or produce electricity; the study of this subject
electrical resistance *n* [C, U] the fact of a substance not allowing electricity to flow through it; a measurement of this
electricity *n* [U] a type of energy that we use to make heat, light, and power to work machines, etc.
electrodynamics *n* [U] the scientific study of the forces involved in the movement of electricity
electromagnetic *adj* (*in physics*) having both electrical characteristics and the ability to attract metal objects
element *n* [C] one of the simple chemical substances, e.g. iron
energy *n* [U] the power used for driving machines, etc.
engineer *n* [C] a person whose job is to design, build, or repair engines, machines, etc.
engineering *n* [U] **1.** the activity of applying scientific knowledge to the design, building, and control of machines, roads, bridges, electrical equipment, etc.; **2.** [U] the study of this subject
enquiry *n* [C] **1.** a question; **2.** an official process to find out the cause of sth
environment *n* [C, U] the conditions that affect the behaviour and development of sb/sth; the physical conditions that sb/sth exists in
environmentally-friendly *adj* (*used about products*) not harming the natural world
equipment *n* [U] the things that are needed to do a particular activity
ergonomically *adj* in a way that is designed to help people's working conditions and to help them work more efficiently
estimate *v* to calculate the size, cost, etc., of sth approximately
evaluate *v* to study the facts and then form an opinion about sth
everyday *adj used* or happening every day or regularly; normal
expand *v* to become or to make sth bigger
experience *n* [U] the things that you have done in your life; the knowledge or skill that you get from seeing or doing sth
expertise *n* [U] a high level of special knowledge or skill
explosive *adj* easily able or likely to explode

F

factory *n* [C] a building or group of buildings where goods are made by machine

fantasy *n* [C, U] a product of your imagination
fasblonable *adj* popular
fitting *n* [U] the act of putting or fixing sth somewhere
fixed *adj* staying the same; not able to be moved or changed
flammable *adj* able or likely to burn easily
flexible *adj* able to bend or move easily without breaking
foil *n* [U] metal that has been made into very thin sheets, used for putting around food
fold *v* to bend one part of sth over another part in order to make it smaller, tidier, etc.; **fold** *n* [C]
force *n* **1.** [U] physical strength or power; **2.** [C, U] a power that can cause change or movement
formal *adj* serious or official
foundation course *n* [C] a general course at a college that prepares students for longer or more difficult courses
frequency *n* [C, U] the rate at which a sound wave or radio wave moves up and down (vibrates)
fuel consumption *n* [U] the act of using heat or power (fuel); the amount of fuel used

G

gadget *n* [C] a small device, tool, or machine that has a particular but usually unimportant purpose
generation *n* **1.** [C] all the people in a family, group, or country who were born at about the same time; **2.** [U] the production of sth, especially heat, power, etc.; **3.** [C, usually *sing*] a stage in the development of a product, usually a technical one
generator *n* [C] a machine that produces electricity
girder *n* [C] a long heavy piece of iron or steel that is used in the building of bridges, large buildings, etc.
goggles *n* [*pl*] special glasses that you wear to protect your eyes from water, wind, dust, etc.
gram *n* [C] (*abbr* **g**) a measure of weight; there are 1,000 grams in a kilogram
grind *v* to make sth sharp or smooth by rubbing it on a rough hard surface
guillotine *n* [C] a machine used for cutting paper

H

half *n* [C] (*symbol* 1/2) one of two equal parts of sth
hand-drawn *adj* drawn or done by a person and not by machine
handle *v* to touch, hold, or move sth with your hands
handmade *adj* made by a person using his/her hands
hard *adj* not soft to touch; not easy to break or bend (*opposite*: **soft**)
hard hat *n* [C] a protective hat
hear *v* to receive sounds with your ears; **hearing** *n* [U]
heavy *adj* weighing a lot; difficult to lift or move (*opposite*: **light**)
height *n* [C, U] the measurement from the bottom to the top of a person or thing
hertz *n* [C] (*abbr* **Hz**) a unit for measuring the frequency of sound waves
highly-skilled *adj* (*used about work*, *a job*, *etc.*) needing a lot of skills or skill; done by people who have been trained to a high degree
Hoover™ *n* [C] a machine that sucks up the dirt
horizontal *adj* going from side to side, flat or level
human error *n* [C, U] a mistake made by a person

I

identical *adj* exactly the same as; similar in every detail
ignite *v* to start burning or to make sth start burning
illegal *adj* not allowed by the law
image *n* [C] **1.** a copy or picture of sb/sth; **2.** the general impression that a person, an organization, etc., gives to the public
imagination *n* **1.** [U, C] the ability to create mental pictures or new ideas; **2.** [C] the part of the mind that uses this ability
implant *n* [C] sth put into the body in a medical operation
increase *v* to become or to make sth larger in number or amount
industrial *adj* connected with industry
industry *n* [U] the production of goods in factories
informal *adj* relaxed and friendly or suitable for a relaxed occasion
injure *v* to hurt or harm sb physically
interesting *adj* enjoyable and entertaining; holding your attention
interference *n* [U] extra noise that prevents you from receiving radio, TV, or phone signals clearly
interview *n* [C] a meeting to find out if sb is suitable for a job, course of study, etc.

invention *n* [C] a thing that has been made or designed by sb for the first time; **inventor** *n* [C]
iron *n* [U] (*symbol* **Fe**) a hard strong metal that is used for making steel and is found in small quantities in food and blood

J

Jacuzzi™ *n* [C] a special bath in which powerful movements of air make bubbles in the water
jet *n* [C] a fast modern plane
joule [ʤu:l] *n* [C] (*abbr* **J**) a unit of energy or work

K

kelvin *n* [C, U] (*abbr* **K**) a unit for measuring temperature
kettle *n* [C] a container with a lid, used for boiling water
key skill *n* [C] a particular ability or type of ability
keyboard *n* [C] the set of keys on a computer, etc.
kill *v* to make sb/sth die
kilogram *n* [C] (*abbr* **kg**) a measure of weight
kilometre *n* [C] (*abbr* **k**, **km**) a measure of length or distance

L

labourer *n* [C] a person whose job involves hard physical work outdoors
lathe *n* [C] a machine that shapes pieces of wood or metal by holding and turning them against a fixed cutting tool
leather *n* [U] the skin of animals which has been specially treated
length *n* [C] the size of sth from one end to the other
lens *n* [C] a curved piece of glass that makes things look bigger, clear, etc., when you look through it
light¹ *n* [U, C] the energy from the sun, a lamp, etc., that allows you to see things
light² *adj* not weighing a lot; easy to lift or move (*opposite*: **heavy**)
lighting *n* [U] the quality or type of lights used in a room, etc.
liquid *n* [C, U] a substance, for example water, that is not solid or a gas and that can flow or be poured
listen *v* to pay attention to sb/sth in order to hear him/her/it
litre *n* [C] (*abbr* **l**) a measure of liquid

local *adj* of a particular place (near you)
look *v* to turn your eyes in a particular direction (in order to pay attention to sb/sth)
loosen *v* to become or make sth less tight

M

mains *n* [*pl*] the place where the supply of gas, water, or electricity to a building starts; the system of providing these services to a building
maintenance *n* [U] keeping sth in good condition
manufacture *n* [U] the fact of making sth in large quantities using machines; **manufacturing** *n* [U]; **manufacturer** *n* [C]
material *n* [C, U] a substance that can be used for making or doing sth
mathematician *n* [C] an expert in mathematics
mathematics *n* [U] the science or study of numbers, quantities, or shapes
measurement *n* **1.** [C] a size, an amount, etc., that is found by measuring sth; **2.** [U] the act or process of measuring sth
mechanical engineering *n* [U] the study of how machines are designed, built, and repaired
mechanism *n* [C] a set of moving parts in a machine that does a certain task
medical *adj* connected with medicine and the treatment of illness
memory *n* [C, U] **1.** a person's ability to remember things; **2.** the part of a computer where information is stored; the amount of space in a computer for storing information
mend *v* to repair sth that is damaged or broken
metal *n* [C, U] a type of solid substance that is usually hard and shiny and that heat and electricity can travel through
methodical *adj* having or using a well-organized and careful way of doing sth
metre *n* [C] (*abbr* **m**) a measure of length; 100 centimetres
micrometre *n* [C] one millionth of a metre
mild steel *n* [U] a strong hard material made from a mixture of iron and carbon
millilitre *n* [C] (*abbr* **ml**) one thousandth of a litre
million *n* [C] 1,000,000
mining *n* [U] the process of getting coal and other minerals from under the ground; the industry involved in this; **miner** *n* [C]

model *n* [C] a copy of sth that is usually smaller than the real thing
modern *adj* with all the newest methods, equipment, designs, etc.
monitor *n* [C] a piece of equipment, connected to a computer, for moving around the screen and entering commands without touching the keys
movable *adj* that can be moved (*opposite*: **fixed**)

N

naturally *adv* in a way that is relaxed and normal
newspaper article *n* [C] a piece of writing in a newspaper
newton *n* [C] (*abbr* **N**) a unit for measuring force
nickel *n* [U] (*symbol* **Ni**) a hard silver-white metal
nuclear *adj* using, producing, or resulting from the energy that is produced when the central part (nucleus) of an atom is split
nylon *n* [U] a very strong man-made material

O

ohm *n* [C] (*symbol* **Ω**) a unit for measuring electrica1 resistance
opaque *adj* that you cannot see through (*opposite*: **clear**)
opener *n* [C] a tool that opens sth or takes the lid, etc., off sth
operator *n* [C] a person whose job is to work a particular machine or piece or equipment
optical fibre *n* [C, U] a thin glass thread through which light can be sent (or transmitted)
organized *adj* arranged or planned in the way mentioned
original *adj* made or created first, before any copies or changes were made

P

parachute *n* [C] a piece of equipment that is tied to a person and that opens and lets him/her fall to the ground slowly when he/she jumps from a plane
particular *adj* used to emphasize that you are talking about one person, thing, time, etc., and not about others
pascal *n* [C] (*symbol* **Pa**) a unit of pressure equal to one newton per square metre
pass *v* to achieve the necessary standard in an exam, a test, etc.

patience *n* [U] the quality of being able to stay calm and not get angry, especially when you have to wait a long time
patient *n* [C] a person who is receiving medical treatment
peaceful *adj* calm and quiet
per *prep* for each
per cent *n* [C] (*symbol* %) one part in every hundred
perfect *adj* completely good; without faults or weaknesses
personality *n* [C, U] the different qualities of a person's character that make him/her different from other people
petrochemical *n* [C] any chemical substance obtained from petroleum oil or natural gas
petroleum *n* [U] mineral oil that is found under the ground or the sea and is used to produce petrol
physicist *n* [C] an expert in physics
physics *n* [U] the scientific study of natural forces
pie chart *n* [C] a diagram consisting of a circle divided into parts to show the size of particular parts in relation to the whole
pier *n* [C] a large structure that is built in the sea or a river to support a bridge where it crosses the water
pilot *n* [C] a person who flies an aircraft
pioneer *n* [C] a person who is one of the first to develop an area of human knowledge, culture, etc.
plant *n* [C] a factory or place where power is produced or where an industrial process takes place
plastic *n* [C, U] a light, strong material that is made with chemicals and is used for making many different sorts of objects; **plastic** *adj*
plug *n* [C] sth which connects a piece of electrical equipment to the electricity supply
plug sth in *phrasal v* to connect a piece of electrical equipment to the electricity supply or to another piece of equipment
point *n* [C] the thin sharp end of sth
polymer *n* [C] a compound consisting of large groups of atoms (molecules) made from combinations of small simple molecules
population *n* [C, U] the number of people who live in a particular area, city or country
power *n* [U] energy that can be collected and used for operating machines, making electricity, etc.; **power** *v* to supply energy to sth to make it work

practical *adj* **1.** concerned with actually doing sth rather than with ideas or thought; **2.** very suitable for a particular purpose; useful
precision *n* [U] the quality of being clear or exact
prepare *v* to get ready or to make sb/sth ready
prevent *v* (**sb/sth from doing sth**) to stop sth happening or to stop sb from doing sth
printer *n* [C] a machine that prints out information from a computer onto paper
process *n* [C] a series of actions that you do for a particular purpose
produce *v* **1.** to make sth to be sold, especially in large quantities; **2.** to cause a particular effect or result; **production** *n* [C]
project *n* [C] a piece of work that is planned and organized carefully
property *n* [C, usually *pl*] a special quality or characteristic
proportion *n* **1.** [C] a part or share of a whole; **2.** [U] the relationship between the size or amount of two things
prototype *n* [C] the first model or design of sth from which other forms will be developed
put sth together *phr v* to build or repair sth by joining its parts together

Q

qualification *n* [C, usually *pl*] an exam that you have passed or a course of study that you have successfully completed
quarter *n* [C] (*symbol* 1/4) one of four equal parts of sth

R

radioactive *adj* sending out powerful and very dangerous rays that are produced when atoms are broken up. These rays cannot be seen or felt but can cause serious illness or death; **radioactivity** *n* [U]
react *v* (*used about a chemical substance*) to change after coming into contact with another substance
realistically *adv* in a sensible and understanding way
receiver *n* [C] a person who gets a letter, a message, etc., from sb
recycle *v* **1.** to put used objects and materials through a process so that they can be used again; **2.** to keep used objects and materials and use them again
referee *n* [C] a person who gives information about your character and ability, usually in a letter, for example when you are hoping to be chosen for a job

register *v* to show sth or be shown on a measuring instrument
relaxed *adj* not worried or tense
reliable *adj* that you can trust
repair *v* to put sth old or damaged back into good condition
repeater *n* [C] a device which automatically transmits or sends again an electronically transmitted message
repetitive strain injury *n* [U] (*abbr* **RSI**) pain and swelling, especially in the wrists and hands, caused by doing the same movement many times
require *v* to need sth
resource *n* [C, usually *pl*] a supply of sth, a piece of equipment, etc., that is available for sb to use
rigid *adj* difficult to bend or shape; stiff
risk *n* [C, U] a possibility of sth dangerous or unpleasant happening; a situation that could be dangerous or have a bad result
robot *n* [C] a machine that works automatically or is controlled by a computer
robotics *n* [U] the science of designing and operating robots
rust *v* to become covered with a reddish-brown substance which forms on the surface of iron, etc., and is caused by the action of air and water

S

safe *adj* not likely to cause danger, harm or risk; **safely** *adv*; **safety** *n* [U]
sanitation *n* [U] the equipment and the systems that keep places clean, especially by removing human waste
scale *n* [C] a series of numbers amounts, etc., that are used for measuring or fixing the level of sth
scientific *adj* connected with or involving science; **scientist** *n* [C]
screw *n* [C] a thin pointed piece of metal used for fixing two things together; you turn a screw with a special tool (a screwdriver)
seabed (the) *n* [*sing*] the floor of the sea
secret *adj* known about by only a few people; kept hidden from others
secretary *n* [C] a person who works in an office; a secretary types letters, answers the telephone, keeps records, etc.
see *v* to become conscious of sth using your eyes
sender *n* [C] a person who sends a letter, a package, etc., to sb

sense[1] *n* [C] one of the five natural physical powers of sight, hearing, smell, taste, and touch

sense[2] *v* to realize or become conscious of sth; to get a feeling about sth you cannot see, hear, etc.

sensible *adj* (*used about people and their behaviour*) able to make good judgements based on reason and experience; practical

sensor *n* [C] a device that can react to light, heat, pressure, etc.

setting *n* [C] one of the positions of the controls of a machine

shape[1] *n* [C, U] the form of the outer edges or surfaces of sth; an example of sth that has a particular form

shape[2] *v* to make sth into a particular form

shape memory *adj* (*used about a substance or material*) able to change and adapt according to its surroundings

side *n* [C] one of the surfaces of sth except the top, bottom, front, or back

sight *n* [U] the ability to see

signal *n* [C] a series of radio waves, etc., that are sent out or received

skill *n* **1.** [U] the ability to do sth well, especially because of training, practice, etc.; **2.** [C] an ability that you need in order to do a job, an activity, etc., well; **skilled** *adj*

sloping *adj* (*used about a surface*) not flat: built at an angle

smart *adj* **1.** (*used about a piece of clothing*) formal; **2.** clever; intelligent; **3.** fashionable

smell *n* [U] the ability to sense things with the nose

socket *n* [C] **1.** a place in a wall where a piece of electrical equipment can be connected to an electrical supply; **2.** a hole in a piece of electrical equipment where another piece of electrical equipment can be connected

soft *adj* not hard or firm

software *n* [U] the programs and other operating information used by a computer

solar energy *n* [U] power from the sun

solution *n* [C] a way of finding the answer to a problem or dealing with a difficult situation

solve *v* to find a way of dealing with a problem or difficult situation

span *n* [C] the length of sth from one end to the other

specialist *n* [C] an expert in a particular area

specialize *v* (**in sth**) **1.** to become an expert in a particular area of work or study; **2.** to give most of your attention to one subject, type of product, etc.
speed *n* [C, U] the rate at which sb/sth moves or travels
splicing *n* [U] the act of joining the ends of two pieces of cable, etc., together
square *adj* (*abbr* **sq**) used after a number to give a measurement of an area
stage *n* [C] one part of the progress or development of sth
state-of-the-art *adj* using the most modern or advanced techniques and methods
statistics *n* [*pl*] numbers that have been collected in order to provide information about sth
Stetson™ *n* [C] a type of hat typical in Texas, USA
stitch *n* [C] one of the small pieces of thread that a doctor uses to sew your skin together after an operation, etc.
strain *n* **1.** [C, U] pressure or worry; **2.** [U] pressure that is put on sth when it is pulled or pushed by a physical force
strength *n* [U] the ability of an object to hold heavy weights or not to break and be damaged easily; **strengthen** *v* to make sth stronger
strong *adj* (*used about a thing*) not easily broken or damaged (*opposite*: **weak**)
structural *adj* connected with the way that a building, etc., has been built or the way that the parts of sth have been put together
substandard *adj* not as good as normal; not acceptable
suction *n* [U] the action of removing air from a space or container so that two surfaces can stick together
supply[1] *n* [C] a store or an amount of sth that is provided or available to be used
supply[2] *v* to give or provide sth
surgery *n* [U] medical treatment in which your body is cut open so that part of it can be removed or repaired
survey *n* [C] a study of the opinions, behaviour, etc., of a group of people
suspension bridge *n* [C] a bridge that hangs from thick steel wires that are supported by towers at each end
symbol *n* [C] a sign, object, etc., that represents sth

symmetrical *adj* having two halves that match each other exactly in size, shape, etc.
symptom *n* [C] a change in your body that is a sign of illness
system *n* [C] a set of ideas or rules for organizing sth; a particular way of doing sth

T

taste *n* [U] the ability to recognize the flavour of a food or drink; **taste** *v*
technical *adj* connected with the practical use of machines, methods, etc., in science or industry
technician *n* [C] a person whose job is keeping a particular type of equipment or machinery in good condition
technique *n* [C] a particular way of doing sth
technology *n* **1.** [U, C] scientific knowledge, used in practical ways in industry; **2.** [C, U] the scientific knowledge and/or equipment that is needed for a particular industry, etc.
teeth brace *n* [C, often *pl*] a metal frame that is fixed to a child's teeth in order to make them straight
telecommunications *n* [*pl*] the technology of sending signals, images, and messages over long distances by radio, telephone, television, etc.
temperature *n* [C, U] how hot or cold sb/sth is
tension *n* [C, U] the condition of not being able to relax because you are worried or nervous
test *v* to use a machine, product, etc., to find out how well it works; **tester** *n* [C]
textile *n* [C, U] any cloth made in a factory
theoretical *adj* based on ideas and principles, not on practical experience
thermometer *n* [C] an instrument for measuring temperature
think *v* to use your mind to consider sth or to form connected ideas
third *n* [C] (*symbol* 1/3) one of three equal parts of sth
thousand *n* [C] 1,000
thread *n* [C] a long thin piece of cotton, wool, etc., that you use for sewing, etc.
tighten *v* to make sth tight or tighter
titanium *n* [U] (*symbol* **Ti**) a silver-white metal that is used in making various strong light materials
tomb *n* [C] a large place, where the body of an important person is buried

ton *n* [C] a measure of weight; 2,240 pounds
tool *n* [C] an instrument that you hold in your hand and use for making or repairing things, etc.
top *n* [C] the highest part or point of sth
touch *n* [U] the ability to feel things and know what they are like by putting your hands or fingers on them; **touch** *v*
tough *adj* not easy to break or damage
tour *n* [C] a short visit around a building, city, etc.
traditional *adj* following the beliefs, customs or way of life of a group of people that have not changed for a long time
transmission *n* [U] sending out or passing sth from one person, place or thing to another

U
under *prep*, *adv* in or to a position that is below sth
unique *adj* not like anything else; being the only one of its type
unplug *v* to remove a piece of electrical equipment from the electricity supply
unreliable *adj* that cannot be trusted or depended on to work properly
upholsterer *n* [C] a person whose job is to cover furniture with soft material and fabric
useful *adj* having some practical use; helpful

V
valve *n* [C] a device in a pipe or a tube which controls the flow of air, liquid or gas, letting it move in one direction only
vehicle *n* [C] smth that transports people or things
vertical *adj* going straight up at an angle of 90° from the ground
viewer *n* [C] a person who looks at or considers sth
vinyl *n* [C, U] a strong plastic that can bend easily and is used for making wall, floor, and furniture coverings
vision *n* [U] the ability to see; sight
volt *n* [C] (*abbr* **V**) a unit for measuring the force of an electric current

W
waiting list *n* [C] a list of people who are waiting for sth, for example, a service or medical treatment, that will be available in the future

waterway *n* [C] a canal, river, etc., along which boats can travel
watt *n* [C] (*abbr* **W**) a unit for measuring electrical power
weak *adj* that cannot support a lot of weight; likely to break (*opposite*: **strong**)
weight *n* [C, U] how heavy sb/sth is; the fact of being heavy
welder *n* [C] a person whose job is joining pieces of metal together by heating their edges and pressing them together; **welding** *n* [U]
welding torch *n* [C] a tool with a very hot flame that is used to join pieces of metal together
wind *v* (**sth up**) to make a clock or other mechanism work by turning a key, a handle, etc., several times
wind-up *adj that* can be made to work by being wound up
wire *n* [C] a piece of metal in the form of a thin thread that is used to carry electricity
wiring *n* [U] the system of wires which supplies electricity to rooms in a building
working environment *n* [C, U] the conditions that sb works in

Z

zero *n* [C] the number “0”

Grammar reference
(Грамматический справочник)

Части речи
(Parts of Speech)

Все слова делятся на разделы, которые называются частями речи. Деление происходит в зависимости от значения, роли в предложении, особенностей словообразования. В английском языке, так же как и в русском, слова делятся на самостоятельные и служебные.

Самостоятельные

1. **Имя существительное** (*noun*, *n*). Обозначает предмет, отвечает на вопросы: «Кто? Что?»
2. **Имя прилагательное** (*adjective*, *adj*). Обозначает признак предмета, отвечает на вопрос «Какой?»
3. **Глагол** (*verb*, *v*). Обозначает действие (или состояние предмета) и отвечает на вопрос «Что делает?»
4. **Числительное** (*numeral*, *num*). Обозначает количество предметов и отвечает на вопрос «Сколько?»; обозначает порядок предметов при счете и отвечает на вопрос «Который?»
5. **Местоимение** (*pronoun*, *pron*). Употребляется вместо существительного или прилагательного.
6. **Наречие** (*adverb*, *adv*). Обозначает признак действия (или обстоятельства, при которых действие протекает) и отвечает на вопросы: «Как? Где? Когда?»

Служебные

7. **Предлог** (*preposition*, *prep*). Показывает отношения между словами в предложении.
8. **Союз** (*conjunction*, *cj*). Показывает отношения между членами предложения.
9. **Междометие** (*interjection*, *interj*).

В английском языке к разряду служебных слов относятся также **артикли**, являющиеся признаком существительного, и **вспомогательные глаголы**, служащие для образования сложных глагольных форм.

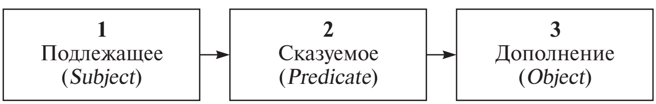
Члены предложения (Parts of Sentence)

Предложение — это сочетание слов, которое выражает законченную мысль. Члены предложения делятся на *главные* (подлежащее и сказуемое) и *второстепенные* (дополнение, определение, обстоятельство). Подлежащее может быть выражено: существительным, местоимением, инфинитивом, герундием, безличным местоимением “*it*”. Сказуемое бывает *простое* и *составное*. Дополнение может быть выражено существительным, местоимением, инфинитивом, герундием. Обстоятельство может быть выражено наречием, существительным с предлогом, герундием с предлогом, инфинитивом, причастием.

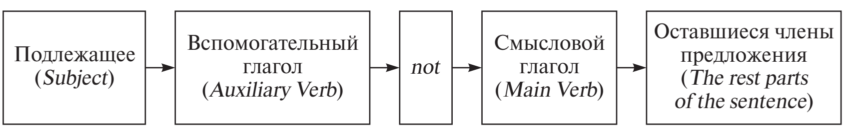
Порядок слов в предложении (Word Order)

В английском языке, в отличие от русского, существует твердый порядок слов в предложении.

В утвердительном предложении порядок слов следующий:



Порядок слов любого отрицательного предложения также един:



Порядок слов вопросительного предложения также един по своей структуре:

Вопросительное слово (*Question Word*) → Вспомогательный глагол (*Auxiliary Verb*) → Подлежащее (*Subject*) → Смысловой глагол (*Main Verb*) → Оставшиеся члены предложения (*The rest parts of the sentence*)

Существительное (Noun)

Отличительными признаками существительного являются наличие артикля и предлога: *an* implant, in *the* laboratory.

Существительные бывают *единственного* (an implant) и *множественного* (implant**s**) числа. Чтобы образовать множественное число существительного, нужно к форме единственного числа прибавить окончание **-s**:

implant — implant**s**
technique — technique**s**

Если существительное оканчивается на *-s*, *-sh*, *-ch*, *-x*, то нужно прибавить окончание **-es**.

address — address**es**
watch — watch**es**
fax — fax**es**
crash — crash**es**

Если существительное оканчивается на согласную + *y*, то буква *y* меняется на *i* и прибавляется окончание **-es**:

factory — facto**ries**
injury — inju**ries**
memory — memo**ries**
company — compan**ies**

Если же существительное оканчивается на гласную + *y*, то просто прибавляется окончание **-s**:

day — day**s**
alloy — alloy**s**

Некоторые существительные образуют множественное число не по правилам:

man — men
woman — women

Существительные бывают *одушевленными* и *неодушевленными*. Все неодушевленные предметы обозначаются местоимением *it*.

Исчисляемые и неисчисляемые существительные (Countable and Uncountable Nouns)

Существительные бывают *исчисляемыми* и *неисчисляемыми*.

Исчисляемые существительные обозначают предметы, которые можно сосчитать: столы, мосты, килограммы, рубли, доллары. Исчисляемые существительные могут употребляться как в единственном, так и во множественном числе.

This bridge *is* very old.

These bridge**s** *are* very old.

Неисчисляемые существительные обозначают предметы, которые нельзя сосчитать: вода, железо, информация, деньги. Неисчисляемые существительные могут употребляться только в единственном числе.

Knowledge *is* power!

Experience *comes* after practice.

С исчисляемыми существительными употребляются слова **many** (много), **a few** (несколько), **few** (мало):

many problems, *a few* components, *few* implants.

С неисчисляемыми существительными употребляются слова **much** (много), **a little** (немного), **little** (мало):

much knowledge, *a little* practice, *little* experience.

Притяжательный падеж существительных (Possessive Case)

В английском языке только два падежа — общий (не имеющий специальных окончаний) и притяжательный (выражающий принадлежность). Роль окончаний в английском языке выполняют либо предлоги, либо положение существительного в предложении.

Существительное в притяжательном падеже отвечает на вопрос whose? (чей?) и показывает, кому принадлежит какой-либо предмет. В форме притяжательного падежа употребляются в основном одушевленные существительные.

Чтобы образовать притяжательный падеж, нужно к существительному прибавить апостроф (**'**) и окончание ***-s***:

the worker**'s** tool
the designer**'s** project
the engineer**'s** solution

Если же существительное стоит во множественном числе, то прибавляется только апостроф (**'**):

the workers' tools
the designers' project
the engineers' solution

Если существительное во множественном числе не имеет окончания ***-s***, то притяжательный падеж образуется, как в единственном числе:

the craftsmen**'s** tools

Существительное в притяжательном падеже стоит перед существительным, к которому оно служит определением:

the worker**'s** tool	инструмент рабочего
the designer**'s** project	проект дизайнера
the engineer**'s** solution	решение инженера

Если речь идет о неодушевленных предметах, то притяжательный падеж выражается с помощью предлога *of*:

properties **of** materials	свойства материалов
symptoms **of** a disease	симптомы болезни

Местоимения (Pronoun)

Местоимение — это часть речи, которая употребляется вместо имени существительного или прилагательного.

Различают следующие виды местоимений: *личные* (**I/me, he/him, she/her, it/it, you/you, we/us, they/them**); *притяжательные* (**my, his, her, its, your, our, their**); *возвратные* (**myself, himself, herself, itself, yourself, yourselves, ourselves, themselves**); *взаимные* (**each other, one another**); *указательные* (**this — these; that — those**); *вопросительные* (**who(m), whose, what, which**); *неопределенные* (**some, any, no; much — many, little — few; each, every**).

Одни местоимения имеют отдельные формы для единственного и множественного числа (*this* — *these*; *that* — *those*); другие — одну и ту же форму для единственного и множественного числа (*which*); третьи — форму только единственного числа (*somebody*) или только множественного числа (*both*, *many*).

Местоимения			
личные		притяжательные	возвратные
Именительный падеж (*кто*?)	*Объектный падеж**	*Отвечают на вопрос «Чей?»*	*Функция дополнения после ряда глаголов*
Единственное число			
I	**me**	**my**	**myself**
you	**you**	**your**	**yourself**
he	**him**	**his**	**himself**
she	**her**	**her**	**herself**
it	**it**	**its**	**itself**
Множественное число			
we	**us**	**our**	**ourselves**
you	**you**	**your**	**yourselves**
they	**them**	**their**	**themselves**

* Соответствует косвенным падежам в русском языке.

Местоимения some, any, no

Неопределенные местоимения **some**, **any** и **no** очень часто употребляются в английском языке. **Some** употребляется в утвердительных предложениях; **any** — в отрицательных и вопросительных предложениях; **no** — только в отрицательных предложениях.

Some обычно переводится как *некоторый*, *какой-то*, *несколько*. **Any** обычно переводится как *какой-нибудь*, *любой* или *никакой* (*в отрицании*). **No** обычно переводится как *никакой*.

К местоимениям **some**, **any**, **no**, а также **every** могут присоединяться такие слова, как **body**, **thing**, **one**, **where**, тем самым образуя сложные местоимения. Принцип их использования в английских предложениях такой же, как у слов **some**, **any**, **no**.

some	something	somebody	someone	somewhere
any	anything	anybody	anyone	anywhere
no	nothing	nobody	no one	nowhere
every	everything	everybody	everyone	everywhere

Прилагательное (Adjective)

Прилагательные в английском языке не изменяются ни по родам, ни по числам, ни по падежам.

Прилагательные имеют две степени сравнения — *сравнительную* (comparative degree) и *превосходную* (superlative degree).

Односложные прилагательные, а также некоторые двусложные прилагательные образуют сравнительную степень с помощью суффикса **-er**, а превосходную степень — с помощью суффикса **-est** (причем в превосходной степени перед прилагательным обязательно ставится определенный артикль **the**).

high — high**er** — **the** high**est**
large — larg**er** — **the** larg**est**
big — bigg**er** — **the** bigg**est**
deep — deep**er** — **the** deep**est**
busy — busi**er** — **the** busi**est**
dirty — dirti**er** — **the** dirti**est**
smart — smart**er** — **the** smart**est**

Если прилагательное оканчивается на немое *e*, то оно опускается при добавлении суффиксов (*large*). Если слово оканчивается на согласную с предшествующим кратким гласным звуком, то конечная согласная удваивается (*big*). Если слово заканчивается на *y* с предшествующей согласной, то *y* меняется при переходе слова в сравнительную и превосходную степени на *i*.

Большинство двусложных прилагательных, а также прилагательные, состоящие из трех слогов и более, образуют сравнительную степень путем постановки перед прилагательным слова **more**, а превосходную степень — путем постановки перед прилагательным слова **most** с определенным артиклем впереди — **the most**.

difficult — **more** difficult — **the most** difficult

interesting — **more** interesting — **the most** interesting
flammable — **more** flammable — **the most** flammable

Некоторые прилагательные представляют собой исключения:

good — better — the best
bad — worse — the worst
little — less — the least
much/many — more — the most
far — farther (further) — the farthest (the furthest)

Глагол (Verb)

В зависимости от значения, формы и функции глаголы подразделяются на отдельные категории. Глаголы бывают:

1) *простые* (не имеющие префиксов и суффиксов — **take**, **do**); *производные* (имеющие префиксы и суффиксы — **minimize**, **discharge**); *составные* (состоящие из двух слов, но обозначающие одно понятие — **broadcast**, **go on**);
2) *личные* (выражающие лицо, число, наклонение, время, залог) и *неличные* (герундий — the Gerund, инфинитив — the Infinitive, причастие — the Participle);
3) *правильные* (образующие вторую и третью форму глагола путем прибавления окончания **-ed**) и *неправильные* (образующие вторую и третью форму глагола путем изменения либо корневой гласной, либо всей формы);
4) *смысловые* (имеют самостоятельное значение) и *вспомогательные* (служащие для образования сложных глагольных форм);
5) *модальные* (выражают возможность, вероятность, необходимость совершения действия).

Смысловые и вспомогательные глаголы (Main Verbs and Auxiliary Verbs)

Смысловые глаголы имеют самостоятельное значение. Они употребляются в предложении в роли простого сказуемого (He **studies** engineering).

Существуют следующие вспомогательные глаголы: **be**, **do**, **have**, **will**. Они выполняют такие основные функции: служат для образования сложных глагольных форм (**is studying**, **have studied**), участвуют в составлении отрицательного предложения (**was not studying**, **has not studied**) и вопросительного предложения (**Did you study? Does she study?**)

Глаголы **do** и **have** являются особенными. Они могут выступать в предложении одновременно в роли как смыслового, так и вспомогательного глагола:

What **do** (*вспомогательный*) you usually **do** (*смысловой*) in the evenings?

Have (*вспомогательный*) you **had** (*смысловой*) anything to eat?

Модальные глаголы (Modal Verbs)

К модальным глаголам относятся: **can** (**be able to**), **may** (**be allowed to**), **must**, **have to**. Модальные глаголы не обозначают само действие, а показывают отношение говорящего к этому действию. Эти глаголы выражают способность, возможность, допустимость, вероятность действия. Они употребляются только в сочетании с инфинитивом смыслового глагола без частицы **to** (исключение представляют собой глаголы **have to**, **be able to**, **be allowed to**, где частица **to** уже включена в данную структуру):

You **can** go...
He **is able to** see...
Jane **is allowed** to go...
They **must** study...
She **has to** do...

Способность к действию передается с помощью глагола **can** (или его эквивалента — **be able to**). В прошедшем времени этот модальный глагол имеет форму **could**, которая употребляется также с инфинитивом без частицы **to**. В будущем времени данный модальный глагол формы не имеет. Вместо него употребляется форма будущего времени модального глагола **be able to** — **will be able to**. При отрицании к модальному глаголу **can** присоединяется отрицательная частица **not**. При вопросе модальный глагол ставится перед подлежащим:

Robots **can** feel the environment.

He **could** feel the cold.

Will you **be able to** solve this problem?

Robots **can't** think like people.

Can robots think like people?

Долженствование передается с помощью модального глагола **must** (или глагола **have to** в значении «быть вынужденным», когда речь идет о долженствовании, вытекающем из внешних условий). В прошедшем и будущем времени модальный глагол **must** формы не имеет. Вместо него употребляются формы прошедшего и будущего времен модального глагола **have to**. При отрицании к модальному глаголу **must** присоединяется отрицательная частица **not**. При вопросе модальный глагол ставится перед подлежащим:

You **must** put on safety gloves.

She **had to** go there.

Jane **will have to** solve the problem herself.

You **must not** enter the laboratory.

Must I do this task?

Выражение разрешения совершить действие передается с помощью модального глагола **may** (или **be allowed to**).

Краткая сводная таблица форм модальных глаголов

	Долженствование	Способность к действию	Разрешение
Present	**must** **have/has to**	**can** **am/is/are able to**	**may** **am/is/are allowed to**
Past	— **had to**	**could** **was/were able to**	— **was/were allowed to**
Future	— **will have to**	— **will be able to**	— **will be allowed to**

Глагол be

Глагол **be** (быть) выражает понятие состояния и очень широко используется в английском языке. В русском языке глагол «быть» в настоящем времени отсутствует, но в английском (и других европейских языках) он ставится. Сравните:

I am an engineer. He is an apprentice. They are highly-skilled craftsmen.	Я (есть) инженер. Он (есть) стажер. Они (есть) высококвалифицированные мастера.

На русский язык глагол **be** может переводиться, в зависимости от контекста, как «есть», «находиться», «являться», «представлять собой»:

I **am** an instructor. — Я *являюсь* инструктором.

He **is** in the laboratory. — Он *находится* в лаборатории.

An alloy **is** a mixture of two metals. — Сплав *представляет собой* соединение двух металлов.

Глагол **be** имеет следующие формы в настоящем, прошедшем и будущем времени:

	Настоящее	Прошедшее	Будущее
I	**am**	**was**	**will be**
He, she, it	**is**		
You, we, they	**are**	**were**	

В отрицательных предложениях к глаголу **be** присоединяется отрицательная частица **not**:

He **is** an apprentice. — He **is not** an apprentice.

They **were** welders. — They **were not** welders.

Чтобы задать вопрос, нужно глагол **be** поставить перед подлежащим:

He **is** an apprentice. — **Is** he an apprentice?

They **were** welders. — **Were** they welders?

Обороты There is/are/was/were/will be

В английском языке для обозначения наличия, существования предмета в настоящем времени очень часто используются обороты **there is** для единственного числа и **there are** для множественного числа:

There is a new office building across the street. — Через дорогу *находится* новое офисное здание.
There are three types of engineering. — В инженерной науке *существуют* три направления.

Вопросительные предложения образуются путем перехода глагола **be** (**is**, **are**) на первое место.

There is a new office building across the street. — **Is there** a new office building across the street?
There are three types of engineering. — **Are there** three types of engineering?

В отрицательных предложениях после глагола **be** (**is**, **are**) употребляется отрицательная частица **not**:

There is a new office building across the street. — **There is not** a new office building across the street.
There are three types of engineering. — **There are not** three types of engineering.

Между двумя следующими предложениями существует смысловая разница:

1. **There is** a welding hat on the table. — На столе лежит шлем (для проведения сварочных работ).
2. The welding hat **is** on the table. — Шлем (для проведения сварочных работ) лежит на столе.

В первом случае идет речь о наличии предмета, во втором — о месторасположении предмета.

В прошедшем времени оборот принимает форму **there was** для единственного и **there were** для множественного числа.

В будущем времени оборот принимает форму **there will be** и для единственного и для множественного числа.

Времена
(Tenses)

В английском языке (как и в любом другом) три времени — настоящее (*Present*), прошедшее (*Past*) и будущее (*Future*). Однако каждое из этих времен подразделяется на виды в зависимости от условий протекания действия: простое (*Simple*), продолженное (*Progressive*) и совершенное (*Perfect*). Наиболее часто используемыми в повседневной жизни и крайне необходимыми для осуществления элементарной коммуникации являются: Present Simple, Past Simple, Future Simple; Present Progressive, Past Progressive; Present Perfect, Past Perfect. Таким образом, получается следующая таблица:

	Simple	Progressive	Perfect
Present	√	√	√
Past	√	√	√
Future	√		

Описание особенностей каждого отмеченного в таблице галочкой элемента видо-временной системы английского глагола представлено ниже. Общая таблица дается после описания времени Future.

Present Simple (настоящее простое)

Время Present Simple обозначает простое, регулярное, часто/редко/обычно/всегда повторяющееся действие. Оно образуется с помощью первой формы глагола без частицы **to**.

I **study** engineering.

Builders **work** on building sites.

В третьем лице единственного числа к основной форме глагола добавляется окончание **-s**. Принцип присоединения окончания такой же, как принцип присоединения окончания **-s** при образовании множественного числа существительных:

I *like* — he *like**s***.

I *get* — he *get**s***.

They *speak* — he *speak**s***.

We *stud**y*** — she *stud**ies***.

We *pla**y*** — she *play**s***.

I *go* — she *go**es***.

I *pass* — he *pass**es***.

Для образования вопросительной и отрицательной форм предложения, стоящего в Present Simple, используются вспомогательные глаголы **do** и **does** (для третьего лица единственного числа). Принцип образования вопросительной и отрицательной форм представлен в таблице.

		I, you, we, they He, she, it		study studies	engineering. engineering.
What When Where Why	**do** **does**	I, you, we, they He, she, it		study? study	 engineering?
		I, you, we, they He, she, it	**do not** **does not**	study study	engineering. engineering.

Если в предложении присутствует вспомогательный глагол **does**, то основной глагол употребляется без окончания **-s**.

При задании *вопроса к подлежащему* не требуется использование вспомогательного глагола. На место подлежащего ставится вопросительное слово **Who** (или **What**, если подлежащее является неодушевленным предметом), и далее следует глагол, *обязательно стоящий в форме третьего лица единственного числа*:

He studie**s** engineering. — **Who** studi**es** engineering?

We study engineering. — **Who** studi**es** engineering?

Present Simple часто употребляется со словами *always*, *usually*, *often*, *sometimes*, *seldom*, *never*, *every day* (*month*, *summer*, *etc.*).

Present Progressive
(настоящее продолженное)

Время Present Progressive обозначает действие, происходящее в данный момент. Оно образуется с помощью глагола **be**, стоящего в соответствующей форме в зависимости от подлежащего (I **am**; he/she/it **is**; you/we/they **are**), и основной формы глагола без частицы **to** с окончанием **-ing**, которое присоединяется к основе глагола (wait — wait**ing**, study — study**ing**, take — tak**ing**).

I **am waiting** for the Head of Engineering Department now. — Я жду главного инженера сейчас.

Jack **is mending** his car at the moment. — Джек ремонтирует свою машину в данный момент.

Where are the builders? — They **are having dinner**. — Где строители? – Они обедают (в данный момент).

Принцип образования вопросительной и отрицательной форм предложения представлен в таблице.

		I He, she, it You, we, they	**am** **is** **are**	study**ing**	now.
What Where Why	**am** **is** **are**	I He, she, it You, we, they		study**ing**	now?
		I He, she, it You, we, they	**am not** **is not** **are not**	study**ing**	now.

При вопросе к подлежащему на место подлежащего ставится вопросительное слово **Who** (или **What**, если подлежащее является неодушевленным предметом), далее следует глагол **be**, *обязательно стоящий в форме третьего лица единственного числа* (**is**), далее следует все без изменений.

She **is studying** now. — **Who is studying** now?

They **are studying** now. — **Who is studying** now?

Present Progressive часто употребляется со словами: *now*, *at the moment*.

Present Progressive *никогда не употребляется* с глаголами, обозначающими чувства, процесс восприятия, мыслительную деятельность: *to love*, *to hate*, *to see*, *to hear*, *to know*, *to want*, *to understand*, etc. С подобными глаголами употребляется Present Simple:

I **want** to go home now. — Я хочу пойти домой сейчас.

Past Simple
(прошедшее простое)

Время Past Simple обозначает простое действие, имевшее место в прошлом и не относящееся к настоящему. Оно образуется с помощью второй формы основного (смыслового) глагола.

В английском языке глаголы бывают двух типов: правильные и неправильные*.

Правильные глаголы образуют форму прошедшего времени с помощью окончания **-ed**, которое присоединяется к основе глагола следующим образом:

to prevent — prevent**ed** to reduce — reduce**d**
to visit — visit**ed** to pla**y** — play**ed**
to wait — wait**ed** to stud**y** — stud**ied**

Неправильные глаголы образуют прошедшую форму путем изменения либо корневой гласной, либо всей своей формы:

to speak — sp**o**ke to write — wr**o**te
to come — c**a**me to go — **went**
to feel — **felt** to buy — **bought**

Предложения в прошедшем времени имеют следующий вид.

This manufacture **produced** the new model of the Mini car last year. — Этот производитель выпустил новую модель автомобиля Mini в прошлом году.

He **felt** burning in the damaged area of his hand. — Он почувствовал жжение на поврежденном участке руки.

Для образования вопросительной и отрицательной форм предложения, стоящего в Past Simple, используется вспомогательный глагол **did**. Принцип образования вопросительной и отрицательной форм представлен в таблице.

		I, he, she, it You, we, they		stud**ied**	engineering last year.
What When Where Why	**did**	I, he, she, it You, we, they		**study**	engineering last year?
		I, he, she, it you, we, they	**did not**	**study**	engineering last year.

В вопросительном и отрицательном предложениях, где присутствует вспомогательный глагол **did**, основной глагол употребляется в первой форме.

* Список трех форм неправильных глаголов приведен в конце данного раздела.

При задании вопроса к подлежащему не требуется использовать вспомогательный глагол. На место подлежащего ставится вопросительное слово **Who** (или **What**, если подлежащее является неодушевленным предметом), и далее следует все без изменений.

He **studied** engineering last year. — **Who studied** engineering last year?

Past Simple часто употребляется со словами *yesterday*, ... *ago*, *last week* (*month*, *summer*, *etc.*).

Past Progressive
(Прошедшее продолженное)

Время Past Progressive обозначает действие, происходившее в определенный момент в прошлом. Оно образуется с помощью форм прошедшего времени вспомогательного глагола **be — was/were —** и основной формы глагола без частицы **to** с окончанием **-ing,** которое присоединяется к основе глагола (wait—wait**ing**, study—study**ing**, take—tak**ing**). Глагол **was** используется для единственного числа, глагол **were** — для множественного.

I **was waiting** for the Head of Engineering Department at 3 pm. yesterday. — Я ждал главного инженера вчера в 3 часа дня.

Jack **was mending** his car when I *phoned* him. — Джек ремонтировал свою машину в тот момент, когда я ему позвонил.

Where were the builders when the accident *happened*? – They **were having dinner**. — Где были строители в тот момент, когда произошло происшествие? – Они обедали (в тот момент).

Past Progressive часто употребляется в предложении с Past Simple, как, например, в двух последних примерах (*phoned*, *happened*):

Jack **was mending** (Past Progressive) his car when I *phoned* (Past Simple) him. — Джек ремонтировал (**продолженное** (длительное) **действие**) свою машину в тот момент, когда я ему позвонил (**определенный момент в прошлом**).

Where were the builders when the accident *happened* (Past Simple)? – They **were having** (Past Progressive) dinner. — Где были строители в тот момент, когда произошло происшествие (**определенный момент в прошлом**)? – Они обедали (**продолженное** (длительное) **действие**) в тот момент.

Принцип образования вопросительной и отрицательной форм предложения представлен в таблице.

		I, he, she, it you, we, they	**was** **were**	studi**ed**	when I *came* home.
What Where Why	**was** **were**	I, he, she, it you, we, they		**study**	when I *came* home?
		I, he, she, it you, we, they	**was not** **were not**	**study**	when I *came* home.

При вопросе к подлежащему на место подлежащего ставится вопросительное слово **Who** (или **What**, если подлежащее является неодушевленным предметом), далее обязательно следует глагол **was** (даже если подлежащее стоит во множественном числе), далее — все без изменений.

She **was studying** when I *came* home. — **Who was studying** when I *came* home?

They **were studying** when I *came* home. — **Who was studying** when I *came* home?

Past Progressive *никогда не употребляется* с глаголами, обозначающими чувства, процесс восприятия, мыслительную деятельность: *to love*, *to hate*, *to see*, *to hear*, *to know*, *to want*, *to understand*, *etc*.

С подобными глаголами употребляется Past Simple.

I **wanted** to go home at 3 o'clock yesterday. — Вчера в 3 часа я хотел пойти домой (*потому что вдруг почувствовал себя плохо*).

Present Perfect (настоящее совершенное)

Время Present Perfect обозначает действие, которое началось в прошлом, длилось в прошлом и завершилось (или еще не завершилось) к моменту речи. Значение имеет сам *результат* деятельности, а не то, когда это действие происходило. Это является основным отличием от Past Simple. Present Perfect образуется с помощью вспомогательного глагола **have** (или **has** — для 3 л. ед.ч.) и третьей формы глагола.

Engineers **have** already **solved** this problem. — Инженеры уже решили эту проблему (неважно, когда они ее решили, важен результат — проблема решена).

The construction **has collapsed**. — Конструкция разрушилась (неважно, когда она рухнула, важно, что конструкции нет).

Принцип образования вопросительной и отрицательной форм предложения, стоящего в Present Perfect, представлен в таблице.

		I, he, she, it you, we, they	**have** **has**	studi**ed** **(found)**	information about implants.
What Where Why	**have** **has**	I, he, she, it you, we, they		studi**ed** **(found)**	(information about implants)?
		I, he, she, it you, we, they	**have not** **has not**	studi**ed** **(found)**	information about implants.

При вопросе к подлежащему на место подлежащего ставится вопросительное слово **Who** (или **What**, если подлежащее является неодушевленным предметом), далее обязательно следует глагол **has** (даже если подлежащее стоит во множественном числе), далее — все без изменений:

The leading engineer has already **solved** this problem. — **Who has solved** this problem?

Engineers **have** already **solved** this problem. — **Who has** already **solved** this problem?

Present Perfect часто употребляется со словами: *already* (в утвердительных, вопросительных предложениях), *just* (в утвердительных предложениях), *yet* (в отрицательных и вопросительных предложениях), *ever* (в вопросительных предложениях), *never* (в отрицательных предложениях):

I have *already* solved this problem.
I have *just* solved this problem.
I have not solved this problem *yet*.
Have you *ever* solved problems?
I have *never* solved problems.

Основное отличие Present Perfect от Past Simple заключается в следующем: Present Perfect свидетельствует о том, произошло ли действие вообще, а Past Simple — о том, когда произошло это действие. Сравните:

Present Perfect:	**Past Simple:**
I **have** already **solved** this problem.	I **solved** this problem *yesterday*.

Past Perfect (прошедшее совершенное)

Время Past Perfect обозначает действие, имевшее место в прошлом и завершившееся до другого действия тоже в прошлом. Оно образуется с помощью вспомогательного глагола **had** и третьей формы глагола.

I **had solved** the problem before my boss *knew* about it. — Я **решил проблему** до того, как о ней *узнал* мой руководитель.

Before employees *started* working, the director had told them the news. — Директор **сообщил** своим работникам новости до того, как они *приступили* к работе.

Во второй части предложений (before my boss *knew* about it и Before employees *started* working) глаголы стоят в Past Simple.

Принцип образования вопросительной и отрицательной форм предложения, стоящего в Past Perfect, представлен в таблице.

		I, he, she, it you, we, they	**had**	studi**ed** **(found)**	the information before the seminar *started*.
What Where Why	**had**	I, he, she, it you, we, they		studi**ed** **(found)**	(the information) before the seminar *started*?
		I, he, she, it you, we, they	**had not**	studi**ed** **(found)**	the information before the seminar *started*.

При вопросе к подлежащему на место подлежащего ставится вопросительное слово **Who** (или **What**, если подлежащее является неодушевленным предметом), далее следует все без изменений:

Jane **had solved** the problem before her boss *knew* about it.
Who had solved the problem before the boss knew about it?

Future
(будущее)

Будущность в английском языке может передаваться разными способами:

1) С помощью глагола will.

Простое будущее время (Future Simple) образуется с помощью вспомогательного глагола **will** и первой формы смыслового глагола:

I **will study** this information tomorrow. — Я ознакомлюсь с этой информацией завтра.
He **will mend** the car next week. — Он починит машину на следующей неделе.
They **will deliver** the components in three days. — Они поставят детали через три дня.

Принцип образования вопросительной и отрицательной форм предложения представлен в таблице.

		I, he, she, it you, we, they	**will**	study	this information tomorrow.
What Where Why	**will**	I, he, she, it you, we, they		study	(this information) tomorrow?
		I, he, she, it you, we, they	**won't (will not)**	study	this information tomorrow.

Простое будущее время часто употребляется со словами *tomorrow*, *next week/year/Friday*.

2) С помощью Present Progressive для выражения будущности.

Будущность может передаваться в английском языке с помощью Present Progressive, если речь идет о запланированном действии.

Jane and Patrick **are studying** tomorrow at 3 p.m. They have an agreement. — Джейн и Патрик занимаются (учатся) завтра в 3 часа дня. Они договорились.

3) Выражение будущности после if… / before… / after… / as soon as… .

Для выражения будущности после if... / before... / after... / as soon as... в английском языке употребляется не будущее время, а время Present Simple.

If they **like** the design, they **will start** the construction. — *Если* им понравится дизайн, они начнут строительные работы.

Before the company **agrees**, it **will study** the project carefully. — *Перед тем как* согласиться, компания тщательно изучит проект.

As soon as we **have** all necessary components, we **will mend** the car quickly. — *Как только* у нас будут все запчасти, мы быстро починим машину.

After she **presents** the project, we **will discuss** it. — *Как только* она представит свою разработку, мы ее обсудим.

Система времен английского языка в активном залоге

V = verb**;** $\mathbf{V_1}$ = первая форма глагола;
$\mathbf{V_2}$ = вторая форма глагола; $\mathbf{V_3}$ = третья форма глагола

Active Voice

	Simple	Progressive	Perfect
Present	$\mathbf{V_1/V_{1\text{-}s}}$ **Do/Does** *always*, *usually*, *often*, *sometimes*, *seldom*, *never*, *every day*	am/is/are + $\mathbf{V_{\text{-}ing}}$ *at the moment*, *now*	have/has + $\mathbf{V_3}$ *already*, *just*, *yet*, *ever*, *never in my life*
Past	$\mathbf{V_2}$ **Did** *yesterday*, *last week/ month/... 2 days/3 weeks/... ago*	was/were + $\mathbf{V_{\text{-}ing}}$ *at 3* (*5*, ...) *yesterday*, *when something happened*	had + $\mathbf{V_3}$ *before something happened*
Future	will + $\mathbf{V_1}$ *tomorrow*, *next week/ month/....*	—	—
	Простое действие (*не привязанное ко времени*)	***В** определенный момент*	***К** определенному моменту*

Заметьте, что в таблице жирным шрифтом выделены только вспомогательные глаголы **do/does** и **did**. Это сделано потому, что эти вспомогательные глаголы отсутствуют в структуре сказуемого в утвердительных предложениях и их необходимо помнить. Во всех же других случаях вспомогательный глагол уже входит в структуру сказуемого в утвердительном предложении.

Также запомните, что вспомогательный глагол **be** работает на группу Progressive, вспомогательный глагол **do** — на группу Simple, вспомогательный глагол **have** — на группу Perfect.

Пассивный залог (Passive Voice)

В английском языке есть два вида залога — *активный* (active) и *пассивный* (passive). Активный залог означает, что подлежащее само выполняет действие, выраженное сказуемым, т.е. подлежащее «активно»:

Engineers **solve** *problems* in methodical way. (Present Simple) — Инженеры решают проблемы согласно алгоритму.

The designer **has made** a symmetrical *image* of a component. (Present Perfect) — Дизайнер создал симметричный образ детали.

The drafter **completed** *the drawing* yesterday. (Past Simple) — Чертежник закончил чертеж вчера.

В этих предложениях слова *problems*, *image*, *the drawing* являются дополнениями. Если дополнение поставить на место подлежащего, а подлежащее на место дополнения, то в русском варианте получатся следующие предложения:

Проблемы решаются инженерами согласно алгоритму.

Симметричный образ детали был создан дизайнером.

Чертеж был закончен чертежником вчера.

Таким образом, подлежащее стало «пассивным»; оно не само выполняет действие, а действие выполняется над ним кем-то. Это и есть пассивная форма, или пассивный залог. В английском языке данные предложения будут выглядеть следующим образом:

Problems **are solved** by engineers in methodical way.

A symmetrical image of a component **has been made** by the designer.
The drawing **was completed** by the drafter yesterday.

Обратите внимание на то, что формы сказуемого изменились.

Общей формулой пассивного залога является формула **be +** $\mathbf{V}_3$. В этой формуле глагол **be** является изменяемой частью, а $\mathbf{V}_3$ — не меняется. Чтобы составить формулы пассива для каждого времени, необходимо поставить глагол **be** в форму нужного времени и прибавить третью форму смыслового глагола.

Passive Voice

	Simple	Progressive	Perfect
Present	am is + $\mathbf{V}_3$ are	am is being + $\mathbf{V}_3$ are	have been + $\mathbf{V}_3$ has
Past	was + $\mathbf{V}_3$ were	was being + $\mathbf{V}_3$ were	had been + $\mathbf{V}_3$
Future	will be + $\mathbf{V}_3$	—	—
	Простое действие (не привязанное ко времени)	***В** определенный момент*	***К** определенному моменту*

В английском языке пассивный залог обычно употребляется в тех случаях, когда важнее дополнение, а не подлежащее.
The best cameras **are made** in Japan.
This bridge **was built** two years ago.
Nowadays drawings **are created** on computers.

Если требуется указать, кем выполняется действие, то это делается с помощью частицы **by**:
Problems are solved **by** engineers.

Наиболее часто употребляются в пассивном залоге формы времен Present Simple, Past Simple, Present Perfect и Future Simple.

Отрицательные и вопросительные предложения в пассивном залоге составляются согласно тем же правилам, что и в активном.
This bridge **was built** two years ago.
This bridge **was not built** two years ago.
When **was** this bridge **built**?

Повелительное наклонение
(The Imperative Mood)

Глагол в повелительном наклонении выражает побуждение к действию. Это может быть приказ, просьба или совет. Утвердительная форма повелительного наклонения представляет собой инфинитив без частицы **to**:

Put on safety gloves!
Beware of toxic material!

Отрицательная форма повелительного наклонения образуется с помощью вспомогательного глагола **to do** и отрицательной частицы **not** (как правило, в краткой форме):

Don't forget to put on safety gloves!
Don't walk here!

Повелительное наклонение может также быть выражено с помощью глагола **let**:

Let him put on safety equipment! — Пусть он наденет средства личной безопасности!
Let them solve this problem themselves. — Пусть они сами решат эту проблему.
Let Jane design the project. — Пусть Джейн разработает проект.

Отрицательная форма данной структуры также образуется с помощью вспомогательного глагола **to do** (как правило, в краткой форме) и отрицательной частицы **not**:

Don't let him work without safety gloves! — Не позволяйте ему работать без защитных перчаток!
Don't let this apprentice work without his instructor. — Пусть этот стажер не приступает к работе без своего инструктора.

Косвенная речь
(Indirect Speech)

Косвенная речь используется для передачи слов другого человека. В косвенной речи могут быть переданы все виды предложений: утвердительные, отрицательные, вопросительные, а также приказы, просьбы, советы и т.п. Существует ряд определенных правил.

1. Предложение, передаваемое в косвенной речи, состоит из двух частей — главного и придаточного предложений:

	Главное	Придаточное
а)	The designer **says**,	"The drawing is perfect."
	Дизайнер говорит:	«Чертеж идеален».

	Главное	Придаточное
б)	The designer **said**,	"The drawing is perfect."
	Дизайнер сказал:	«Чертеж идеален».

Разница в этих двух предложениях лишь в том, что в первом случае (а) глагол в главном предложении стоит в настоящем времени (*says*), а во втором случае (б) — в прошедшем (*said*). Но в косвенной речи эти предложения будут переданы по-разному. В первом случае (а) предложение останется без изменений:

(а) The designer **says** that the drawing is perfect.

Во втором случае (б) время в придаточном предложении будет изменено на прошедшее:

б) The designer **said** that the drawing **was** perfect.

(т.е. в примере «б» в придаточном предложении сказуемое **is perfect** заменилось на **was perfect**).

Это правило называется **правилом согласования времен**. Суть его сводится к тому, что если сказуемое в главном предложении стоит в прошедшем времени, то сказуемое в придаточном предложении при переводе в косвенную речь меняется на одно из прошедших.

Таким образом:
am/is → was
are → were
have/has → had
will → would
can → could
do/want/know... → did, wanted, knew...
did/wanted/knew → had done/had wanted/had known.

2. Соответствующим образом меняются личные и притяжательные местоимения:

а) The engineer said, "**I** will give **you** some advice."
The engineer said that **he** would give **me** some advice.

б) The manufacturer said, "**We** have delivered the components to **you.**"
The manufacturer said that **they** had delivered the components to **us**.

3. Указательные местоимения, обстоятельства времени и места изменяются следующим образом:

this → that	yesterday → the day before
these → those	tomorrow → next day, the following day
here → there	last night → previous night
now → then	a year ago → a year before
ago → before	a few days ago → earlier
today → that day	

He said, "I solved **this** problem **yesterday.**" → He said that **he** had solved **that** problem **the day before**.

4. Если в предложении в прямой речи есть указание на того, к кому обращаются, независимо от глагола чаще всего в косвенной речи употребляется глагол **tell** (или **told**) с указанием лица (*tell somebody/told somebody*).
а) She **said** *to the Top Manager*, "I am interested in working for the company." → She **told** *the Top Manager* that she was interested in working for the company.
В косвенной речи с глаголом **told** частица **to** (из выражения *to the manager*) не употребляется.
б) She **said**, "I am interested in working for the company." → She **said** that she was interested in working for the company.

Особенности перевода в косвенную речь утвердительных предложений

При переводе утвердительных предложений из прямой речи в косвенную используется слово **that**. В данном случае действуют все четыре правила, приведенные выше.

Особенности перевода в косвенную речь вопросительных предложений

При переводе вопросительных предложений из прямой речи в косвенную также действуют все четыре правила, приведенные выше. В главном предложении используется глагол **ask** (или

asked). При переводе в косвенную речь порядок слов вопросительного предложения изменяется на порядок слов утвердительного предложения:

вопросительное предложение	*Where is she?* (*сказуемое* → *подлежащее*)
утвердительное предложение	She is at home. (*подлежащее* → *сказуемое*)

She asked me where **we met**. (подлежащее → сказуемое)
He asked her when **she was going** to come back. (подлежащее → сказуемое)

Если вопрос в прямой речи не имеет вопросительного слова, то в косвенной речи он в качестве придаточного предложения присоединяется к главному с помощью союзов **if** и **whether**.

"Have you solved this problem?" → She asked me **if I had solved that problem**.
"Did you complete the drawing?" → He asked me **whether** I had completed the drawing.

Особенности перевода в косвенную речь просьб, приказов, советов

Просьбы, приказы, советы в косвенной речи выражаются инфинитивом, т.е. глаголом в первой форме. Если это приказ, то в главном предложении используется, как правило, глагол **tell** (или **told**). Если это просьба, то используется глагол **ask** (или **asked**).

Приказ "Put on safety gloves!" → He told me **to put** on safety gloves.
Просьба "**Please**, don't walk here." → He asked me **not to walk** there.

List of irregular verbs
(Таблица неправильных глаголов)

be	was/were	been	быть
beat	beat	beaten	бить
become	became	become	становиться
begin	began	begun	начинать(ся)
bite	bit	bitten	кусать(ся)
blow	blew	blown	дуть
break	broke	broken	ломать
bring	brought	brought	приносить
build	built	built	строить
buy	bought	bought	покупать
catch	caught	caught	ловить
choose	chose	chosen	выбирать
come	came	come	приходить
cost	cost	cost	стоить
cut	cut	cut	резать
do	did	done	делать
draw	drew	drawn	тащить; рисовать
drink	drank	drunk	пить
drive	drove	driven	везти
eat	ate	eaten	есть
fall	fell	fallen	падать
feel	felt	felt	чувствовать
fight	fought	fought	бороться
find	found	found	находить
fly	flew	flown	летать
forget	forgot	forgotten	забывать

get	got	got	получать, становиться
give	gave	given	давать
go	went	gone	идти, ехать
grow	grew	grown	расти, выращивать
hang	hung	hung	вешать, висеть
have	had	had	иметь, обладать
hear	heard	heard	слышать
hide	hid	hidden	прятать(ся)
hit	hit	hit	ударять
hold	held	held	держать
hurt	hurt	hurt	причинять боль
keep	kept	kept	держать, хранить
know	knew	known	знать
leave	left	left	покидать, оставлять
lend	lent	lent	давать взаймы
let	let	let	позволять
lie	lay	lain	лежать
light	lit	lit	зажигать
lose	lost	lost	терять
make	made	made	делать, создавать
mean	meant	meant	значить, иметь в виду
meet	met	met	встречать(ся)
pay	paid	paid	платить
put	put	put	класть, ставить
read [ri:d]	read [red]	read [red]	читать
ride	rode	ridden	ехать верхом
ring	rang	rung	звонить, звенеть
rise	rose	risen	подниматься, вставать
run	ran	run	бежать

say	said	said	сказать, говорить
see	saw	seen	видеть
sell	sold	sold	продавать
send	sent	sent	посылать
shine	shone	shone	светить(ся)
shoot	shot	shot	стрелять
show	showed	shown	показывать
shut	shut	shut	закрывать
sing	sang	sung	петь
sit	sat	sat	сидеть
sleep	slept	slept	спать
speak	spoke	spoken	говорить, разговаривать
spend	spent	spent	тратить
stand	stood	stood	стоять
steal	stole	stolen	красть
swim	swam	swum	плавать
take	took	taken	брать
teach	taught	taught	учить
tear	tore	torn	рвать
tell	told	told	говорить, рассказывать
think	thought	thought	думать
throw	threw	thrown	бросать
understand	understood	understood	понимать
wake	woke	woken	просыпаться, будить
wear	wore	worn	носить (одежду)
win	won	won	побеждать
write	wrote	written	писать

Additional texts for reading
(Тексты для дополнительного чтения)

Изучение дополнительных текстов по той или иной теме курса носит вариативный характер. Тексты, а также форма работы с ними выбираются преподавателем или студентом самостоятельно.

Тематика текстов, представленных в данном разделе:

1	ENGINEERING AND ART	Module 1
2	ENGINEERING AND MEDICINE/BIOLOGY	Module 1
3	ENGINEERING IN A SOCIAL CONTEXT	Module 1
4	SCIENTISTS AND ENGINEERS	Module 1
5	WHY STUDY ENGINEERING?	Module 1
6	CAREERS IN CIVIL ENGINEERING	Module 2
7	CAREERS IN ELECTRONIC ENGINEERING	Module 2
8	CAREERS IN MECHANICAL ENGINEERING	Module 2
9	HOW UNIVERSITY CAN BENEFIT YOUNG PEOPLE	Module 3
10	IS HIGHER EDUCATION FOR YOU?	Module 3
11	PROPERTIES OF MATERIALS (1)	Module 4
12	PROPERTIES OF MATERIALS (2)	Module 4
13	ALLOYS	Module 5
14	COMPUTER USAGE IN ENGINEERING	Module 8
15	CANALS	Module 12
16	CHOICE OF TUNNELS VS BRIDGES	Module 12
17	HISTORY OF DAMS	Module 12
18	HISTORY OF TUNNELS	Module 12
19	A ROBOTIC SPACECRAFT	Module 14

20	EFFICIENCY OF BRIDGE CONSTRUCTION	Module 16
21	HISTORY OF BRIDGES	Module 16
22	THE MILLENNIUM BRIDGE (KAZAN)	Module 16
23	THE USAGE OF BRIDGES	Module 16
24	THE EXAMPLES OF ANCIENT ARCHITECTURAL STRUCTURES	Module 17

Возможные формы работы с текстами:

— чтение и перевод;

— чтение и пересказ;

— чтение и составление краткого содержания текста;

— чтение и составление вопросов к тексту;

— чтение и лексический анализ (определение ключевых лексических единиц; подбор синонимов, антонимов; составление словосочетаний; формирование навыка их употребления в требуемом контексте);

— чтение и функциональный анализ текста (интерпретация информации согласно заданным параметрам, ранжирование информации, представление информации в графическом виде: схемы, таблицы;

— самостоятельное составление заданий к тексту преподавателем исходя из конкретных условий протекания учебного процесса.

При работе над текстами рекомендуется использование толкового языкового словаря; англо-русского словаря (в зависимости от формы работы с текстом).

1. ENGINEERING AND ART

There are connections between engineering and art. They are direct in some fields (for example, architecture, landscape architecture, and industrial design) and indirect in others.

The Art Institute of Chicago, for instance, held an exhibition about the art of NASA's aerospace design. At the University of South Florida, an engineering professor, through a grant with the National Science Foundation, has developed a course that connects art and engineering.

Among famous historical figures Leonardo Da Vinci is a well-known Renaissance artist and engineer, and a prime example of a link between art and engineering.

2. ENGINEERING AND MEDICINE/BIOLOGY

The study of the human body is an important common link between medicine and some engineering disciplines. Medicine aims to help human body and in some cases, to replace functions of the human body, if necessary, through the use of technology.

Modern medicine can replace several of the body's functions through the use of artificial organs and can significantly change the function of the human body through artificial devices such as, for example, brain implants and pacemakers. The fields of bionics and medical bionics are dedicated to the study of synthetic implants which belong to natural systems.

Some engineering disciplines view the human body as a biological machine which must be the object of study. So they try to imagine many of its functions by replacing biology with technology. This has led to fields such as artificial intelligence, neural networks, fuzzy logic, and robotics. There are also substantial interdisciplinary interactions between engineering and medicine. Medicine studies the function of the human body. The human body, as a biological machine, has many functions that can be modeled using engineering methods.

The heart, for example, functions much like a pump, the skeleton is like a linked structure with levers, the brain produces electrical signals, etc. These similarities has led to the development of the field of biomedical engineering that uses concepts developed in both disciplines.

So, both fields provide solutions to real world problems. Therefore, experimentation and empirical knowledge is an integral part of both.

3. ENGINEERING IN A SOCIAL CONTEXT

Engineering is a subject that ranges from large collaborations to small individual projects. Almost all engineering projects depend on some sort of financing agency: a company, a set of investors, or a government.

By its very nature engineering is connected with society and human behavior. Every product or construction used by modern society is influenced by engineering design. Engineering design is a very powerful tool to make changes to environment, society and economies, and its application brings with it a great responsibility. Many engineering societies have established codes of practice and codes of ethics to guide members and inform the public at large.

Engineering projects can be subject for discussion. Examples from different engineering disciplines include the development of nuclear weapons, the design and use of sport utility vehicles and the extraction of oil. In response, some western engineering companies have enacted serious corporate and social responsibility policies.

Engineering is a key driver of human development. For example, Sub-Saharan Africa in particular has a very small engineering capacity. Therefore, many African nations are unable to develop infrastructure without outside aid. The main goal nowadays is to achieve sufficient engineering capacity to develop infrastructure and maintain technological development.

Today there are a lot of different charitable organizations which aim is to use engineering directly for the good of mankind. Among these organizations are the following ones: Engineers Without Borders, Engineers Against Poverty, Registered Engineers for Disaster Relief, Engineers for a Sustainable World.

4. SCIENTISTS AND ENGINEERS

“*Scientists study the world as it is*;
engineers create the world that has never been.”
Theodore von Kármán

There exists a specific connection between the sciences and engineering practice. In engineering, people apply science. Both areas, science and engineering, rely on accurate observation of materials and phenomena. Both use mathematics and classification criteria to analyze and communicate observations.

Scientists must interpret their observations and make recommendations for practical action. Scientists may also have to complete engineering tasks, such as designing experimental apparatus or building prototypes. On the other hand, in the process of developing technology engineers sometimes explore new phenomena and become scientists themselves.

In the book *What Engineers Know and How They Know It*, Walter Vincenti says that engineering research differs from scientific research. First, it often deals with areas in which the basic physics and/or chemistry are well understood, but the problems themselves are too complex to solve in an exact manner. Examples are the use of numerical approximations to the Navier—Stokes equations to describe aerodynamic flow over an aircraft, or the use of Miner’s rule to calculate fatigue damage. Second, engineering research employs many semi-empirical methods that are too far from pure scientific research, one example being the method of parameter variation.

As stated in the revision to the classic engineering text, *Foundations of Solid Mechanics*: “Engineering is quite different from science. Scientists try to understand nature. Engineers try to make things that do not exist in nature. Engineers stress invention. To embody an invention the engineer must put his idea in concrete terms and design something that people can use. That something can be a device, a gadget, a material, a method, a computing program, an innovative experiment, a new solution to a problem, or an improvement on what is existing. Since a design has to be concrete, it must have its geometry, dimensions, and characteristic numbers. Almost all engineers working on new designs find that they do not have all the needed information. Most often, they are limited by insufficient scientific knowledge. Thus they study mathematics, physics, chemistry, biology and mechanics. Often they have to add to the sciences relevant to their profession. Thus engineering sciences are born."

5. WHY STUDY ENGINEERING?

(*adapted from* http://www.science-engineering.net)

Engineering is the way of realization of technological progress. Engineers and engineering make a major impact in the everyday lives of most of us. Engineering qualifications and experience are a foundation for many different careers.

In recent times it has become fashionable to talk about post-industrialized economies—in which services take over from manufacturing under the "law" of comparative advantage. This theory is substantially flawed. Services are more difficult to export than manufactured goods, and in any event a significant part of demand for services comes from the manufacturing sector itself. Therefore engineering—the realization of technological progress—is crucial to creating a modern balanced economy.

This does not overlook the inevitability of migration of some activities as part of the phenomenon known as globalization. But the notion that is still held by some governments is that manufacture and export constitute a "good" model and globalization (export of jobs and value creation) is "bad" and dangerously misleading. As markets become more integrated and the borders between nation states become less rigid and regions emerge as the rational units of economic activity, the question arises as to what activities logically belong within a region and what should be outsourced to more appropriate locations. Engineers applying the tools and techniques of modern engineering have accelerated this process of greater organizational fluidity and a more international approach to satisfying demand wherever it arises. Value creation is becoming less constrained geographically—information engineering is accelerating this process of change.

This evolution is either exciting or scary, depending how you look at it. Let us consider just three significant issues.

Firstly, in many engineering activities we see a new kind of challenge emerging—increasingly international business structures. Research and development can take place in one location, materials and subassemblies can be sourced from several locations worldwide, manufacture can take place in areas located far from R&D and raw material supply and final markets can be anywhere. The skill of the engineer in designing information systems and configuring operational technology determines how all this fits together competitively and profitably. It means that an engineer can face the challenge of coping with multi-location, multi-cultural relationships at a very early stage of a career.

Secondly, engineers have been at the forefront of turning time into a distinguishing feature of the product creation process. With a faster and more even distribution of "know-what" and "know-how" the difference between success and failure can depend on speed-to-market. This requires a high level of engineering knowledge and skill in operational system design and supply chain management to achieve what is commonly termed "time compression".

Thirdly, it is sometimes said that certain developed countries are "post-industrial". This is, I believe, short-sighted. What is happening is that the structure of industrial activity is shifting in a way that locates individual functions where they logically belong. Therefore we find in the more advanced economies of the world those parts of the supply chain and operational functions that are best placed there. Conversely the activities in which other countries enjoy a comparative advantage will attract other activities. Modern systems engineering addresses this issue head-on.

Engineers have often found themselves in key positions in industry and commerce. The reasons for this are easy to discern, given the importance of systems technologies in any modern economy and the trends to globalization outlined above. However this trend goes further and broader than businesses that can be classified as "engineering". To take just one example, the Chairman of one of the UK's leading banks (Sir George Mathewson of the Royal Bank of Scotland Group) is a highly qualified engineer whose global experience has propelled the bank into major initiatives on behalf of leading international clients. This will be less of an exceptional case as we move ahead in an increasingly global industrial economy.

As a closing remark I find myself referring to a recent article by one of the UK's most distinguished engineers, Lord Bhattacharyya, Professor of Systems Engineering at the University of Warwick. Writing in the February 2006 issue of the journal of the Royal Society of Arts, Manufactures and Commerce, Lord Bhattacharyya advances a very powerful argument for developing in the UK the same level of skills that are found in financial engineering in what he terms "real" engineering. This will involve a more collaborative approach to relationships, recognizing that globalization provides as many opportunities as threats and understanding how a new generation of engineers stand to gain most by this process of change. It is truly a "revolution in the making" that emphasises the value and potential of studying engineering in the early 21st century.

Dr Daniel Park
Partner
MASS Consulting Group, Manchester, UK

6. CAREERS IN CIVIL ENGINEERING

(http://www.science-engineering.net)

Professional qualifications

Just like other professionals, such as doctors, lawyers, architects, teachers, and accountants, members of a construction team also study for academic qualifications, train at work, and then obtain their professional qualifications through one of many professional institutions.

Professional qualifications are important in all sections of the industry, as they are an independent review by peers to confirm the technical and managerial competence and professional experience of individuals.

For example, in engineering there is a national body (the Engineering Council), which ensures that all institutions work to the same high standard.

There are three grades of professional qualification that the Council awards, common to all disciplines: engineering technician (EngTech), incorporated engineer (IEng) and chartered engineer (CEng).

An engineering technician (EngTech) has:

- a BTECH/SCOTVEC (BSc) National Certificate in Engineering;
- training at the workplace;
- a "pass" from a professional review or examination set by a professional body.

An incorporated engineer (IEng) has:

- an accredited BSc degree in engineering;
- training at the workplace;
- a "pass" from a professional review or examination set by a professional body.

A chartered engineer (CEng) has:

- an accredited honours degree in engineering;
- a "pass" from a professional review or examination set by a professional body.

Within civil engineering, for example, the Institution of Civil Engineers registers its qualified members with the Engineering Council.

Chartered engineers, who will normally be Members (MICE), study civil engineering to masters degree level and make sure that their chosen degree is accredited for membership. They will receive training during their first few years at work (professional development normally forming part of this), before submitting themselves for a professional review.

Gaining an academic qualification is just the beginning, on the road to becoming professionally qualified. The timing for the final assessment really depends on the experience gained, which only individuals and their employers will be able to judge. They are at the forefront of knowledge, creating rapid changes in the world. They are the managers of high risk and capital intensive projects in the construction industry. The training and experience will have given them a broad understanding of the engineering principles that guide and direct the construction industry.

Incorporated engineers, who will normally be Associate Members (AMICE), study civil engineering to the level of a BSc degree, and are trained at their workplace by their employer. This training will normally include both technical practice and professional development. When they have achieved the required levels of technical and professional competence, they submit themselves for a professional review. Often, as team leaders, incorporated engineers are responsible for the efficiency of the team in which they are working, and for carrying out tasks and solving engineering problems using up-to-date engineering knowledge. Incorporated engineers are regularly acknowledged as having a depth of understanding and expertise that develops them into specialists in their particular fields.

Engineering technicians and technician members within the ICE study civil engineering to the level of a BTEC Certificate, and are trained at the workplace by their employer. They submit themselves for the professional review of the ICE when their training and experience has enabled them to reach the level of proficiency required by the Institution. They are normally responsible for solving engineering problems using standard procedures.

Civil engineers are successfully trained in an extraordinary variety of organizations, operating in research, design and construction, in both the public and private sectors. No longer are civil or structural engineers just the people who design steel bridges or concrete structures. There are many subject areas that span civil and structural engineering and the institutions, and between them, they welcome and invite membership from engineers in a wide variety of specialisms, in addition to the usually-perceived skills.

Your career will continue with learning in an academic style, as well as practical training and experience, throughout your working life. There will be various milestones as you progress. We never cease learning, albeit in different environments and by different methods, but it is the one constant thing that will always be happening.

***What do civil engineers do*?**

Civil engineers turn complex ideas into reality. They help make some of the most innovative structures in the UK and abroad.

What do they do?

Civil engineers are involved in the design and construction of bridges, tunnels, roads, railway, dams, pipelines, and major buildings. The infrastructure for transport, energy, industry, and commerce is the result of civil engineering. Our society would not function without civil engineering products.

Civil engineers are usually found in one of the following organisations:

— Contractors—who traditionally manage the construction work on site, develop and design construction processes and techniques and supervise a professional team.
— Consultants—who are concerned with the design and planning of projects and their effect on the environment.
— Public service organization and utilities—who investigate the need for roads, bridges, tunnels, etc., and then maintain and manage the structures once they are there.

As new ways of working evolve, the lines between these types of organization are blurring. For example, all three types of organization might pool their expertise to raise the money to design, build, and maintain a really large project.

Generally speaking, civil engineers do different work from structural engineers who are involved primarily in the design of structures—that is, the shape and form of buildings, oil rigs, power stations, ports, airports. For this reason structural engineers work less on transport projects like roads and pipelines.

There are three kinds of civil engineer:

— Engineering technician, who has basic knowledge of engineering principles and vital technical skills.
— Incorporated engineer, who uses technical knowledge and good management skills to lead project teams.
— Chartered engineer, who is an innovator at the forefront of design solutions.

Civil engineering: highways

Highways civil engineering is concerned with improving, designing, and maintaining roads of all sizes (from motorways to B-roads), in all sorts of location. Work can include:

— Planning and supervising a wide range of projects.
— Presenting detailed designs.
— Taking into account the effect on the environment.
— Communicating and negotiating with clients and other professionals.
— Ensuring safety and efficiency of existing road networks.
— Preparing contract documentation.
— Site supervision.

Currently there is a high demand for highways engineers.

Civil engineering: transport

Chartered engineers specializing in the transport sector focus on the design, construction and maintenance of structures, supporting transport networks, such as bridges, tunnels, and railway tracks. Their responsibilities include:

— Using specialist knowledge of the ground or soil conditions to design tunnels, bridges, etc.
— Planning how to improve passenger comfort.
— Providing a transport system which will be safe, efficient, and good value for money.
— Finding new solutions to transport problems.
— Overseeing the laying and alignment of railway tracks.
— Analysing the effects on the environment.
— Liaising with clients and other construction professionals.

There is also a high demand for transport engineers.

Civil engineering: water and marine

This area of civil engineering encompasses all kinds of coastline developments including jetties, piers, harbour work, docks and flood protection, plus any other structures used for carrying, storing, or distributing water and wastewater. The work can include:

— Co-ordinating a large team of engineers.
— Designing engineering solutions which work and which meet the client's budget.
— Using sophisticated equipment to carry out complex work on the water.
— Doing detailed calculations to make sure that everything goes exactly where it should.

— Carrying out safety inspections on site.
— Sorting environmental issues.
— Consulting closely with other organizations and professionals—even divers!

What are they good at?

Civil engineers need a good grasp of mathematics and design, and the ability to manage and liaise with a wide variety of people. They need to be able to think in 3D and communicate ideas effectively. This kind of engineering is suited to people who are practical with a creative streak.

How do I get there?

There are so many different aspects to civil and structural engineering that courses at different levels will cover a wide range of subjects and develop many important skills. If you are fascinated by structures and how they are built, then a course or degree in civil engineering is for you.

Age 16+

Although you won't have studied civil engineering in school, you will have studied some relevant subjects like maths, design & technology, IT and physics. Geography, geology, and economics might also come in handy. You can apply knowledge of these subjects to new ones you will learn about in a HND, such as:
— materials;
— measurement;
— structural mechanics;
— civil engineering construction;
— civil engineering administration;
— investigation and inspection;
— environment science;
— soils and water;
— surveying;
— highway design.

Most courses are very practical and offer the opportunity to try out academic theories on field trips. You'll be amazed at how quickly you apply the theory of civil engineering and structures to real-life examples.

Age 18+

In the first year of a degree you will probably cover the core subjects of structural, geotechnical and fluid engineering. The main elements will include:

— theory of structures;
— structural mechanics;
— structural design;
— soil mechanics;
— geology;
— construction management;
— computer methods;
— field studies.

In your later years you will broaden and deepen your knowledge in these areas and have the option of specializing in others, such as:

— highway construction and maintenance;
— traffic and transportation;
— structural engineering;
— environmental issues;
— costal engineering.

Because of the number of people now entering higher education, Engineering Council regulations have recently changed to help universities provide engineering courses of different types and levels to suit people with a wide range of abilities and ambitions. Entry qualifications for courses are strict and choosing an accredited course is very important if you want to take the most direct route to professional qualifications. There are now three specific pathways students can take to become a civil of structural engineer:

— Becoming a chartered engineer, by taking an accredited four-year MEng degree and completing carefully controlled training in the workplace.
— Becoming an incorporated engineer, through an accredited IEng degree (many new ones are being developed) or an accredited HND/HNC course plus a further year's learning, also called a matching section.
— Becoming an engineering technician, through an advance GNVQ, NC, or ND course.

Remember that academic study is just the start of the process towards professional qualifications.

To find out more about routes to qualification and what they mean for you, try to get hold of some university prospectuses or contact relevant professional organizations such as the Institution of Civil Engineers.

Why civil engineering?

Civil engineering offers a flexible, well-rewarded and diverse career with the chance to work and travel all over the world.

Our society would not work without civil engineering. Infrastructure supports our daily life—roads and harbours, railways and airports, hospitals, sports stadiums and schools, access to drinking water and shelter from the weather. Because it works, we take it for granted. Only when parts of it fail, or are taken away, do we realize its value.

Today, civilization relies more than ever on teams of inventive people to design, build and maintain the sophisticated environment that surrounds us. People who find they are drawn to civil engineering as a career look to find challenge, self-expression, achievement, and personal reward through their work. If you would like to combine your technical knowledge and creative flair to solve problems, civil engineering is an excellent career choice.

Soon you will be making decisions about your career. We can't make those decisions for you, but we can offer guidance, advice, information, and the opportunity to become a professionally qualified engineer.

Have a say in what the world will look like

How many jobs affect how our environment looks and works? For many civil engineers, it is the way they can change our surroundings and improve the lives of millions of people that draws them to the profession. They see whole projects through each stage from feasibility to design and implementation.

Help the developing world

For civil engineers, solving infrastructure problems in the developing world is just as demanding—and rewarding—as solving problems in the developed world.

They are needed after earthquakes, during droughts and at times of war, to help the local population rebuild or maintain the conditions that will keep them alive. If you have a real sense of adventure and a commitment to help those in the greatest need, you could join RedR, an organization that sends volunteers to disaster areas all over the world.

International opportunities

Civil engineering offers unparalleled opportunities to work overseas. By becoming professionally qualified, you will be able to enter the international workplace and work abroad for the short or long term.

Job satisfaction

The major highlight for most civil engineers is the satisfaction of seeing tangible results of their hard work, from designing and constructing Heathrow Terminal 5 to rebuilding bridges in war torn Iraq. The infrastructure civil engineers create benefits society for many years to come.

For more information on studying civil engineering contact: **The Institution of civil engineers** at: *www.ice.org.uk*.

7. CAREERS IN ELECTRONIC ENGINEERING

(http://www.science-engineering.net)

Electronics is fundamental to many of the things we take for granted today. Everything from mobile phones to aircraft and medical equipment relies on electronics, and it is difficult to think of any area of life that has not been affected by developments in electronics.

Technology, and particularly electronics, is developing at a more rapid pace than ever before. This makes the job of the electronic engineer both exciting and challenging, but it also means that there are great rewards for engineers, both in terms of remuneration and job satisfaction.

An international career

Today, engineering in general—and electronics in particular—is an international business. Most of the well-known companies in electronics operate not just in several countries, but across continents, and many smaller companies depend on international trade for their business. In order to compete in this situation, companies recruit engineers from around the world. To succeed, engineers need to have internationally recognized qualifications.

Qualifications themselves are only one of the benefits to be gained from study abroad. A successful career depends on who you know as well as what you know, and the people that you study with are likely to become important contacts once you leave university. If you choose a suitable course, the people who are classmates today will be the leaders of tomorrow.

Britain has long been recognized for its success in engineering and technology innovation, and this reputation is built on an excellent education system. The engineering knowledge you gain in a British university is, of course, the same as you would in any other country, but there are differences in the way these are taught and learnt from many others. You need to be aware of these differences of approach and expectation before you start to study.

In most courses in Britain, there is a lot of emphasis placed on learning to think for yourself and study on your own. This can come as a shock to students who are used to being given all of the information they need, but independent learning skills are vital once you start a real job, solving problems that have never been encountered before. Fortunately, courses develop these skills gradually, with plenty of support available to ensure your confidence is built up.

Engineering courses in Britain are shorter than in many other countries, being three or four years in length. Most students complete the course within this time, since it is unusual for students to repeat years. So although course fees may seem high, the overall cost of study in Britain can be lower than elsewhere.

Choosing a course

Deciding what to study and where to study it is a big decision, both in terms of time and money, and so it is vital that you choose the right course and the right university. To make the right decision you have to take account of many different factors, as outlined below.

Looking at the lists of courses available, it is easy to be confused by the wide choice, ranging from straightforward electronic engineering to more specialist courses, such as communications, semiconductor devices, or microelectronics. There is also a wide range of joint courses, combining electronics with computer science or language studies, for instance.

An electronic engineering course will cover all of the key knowledge and skills required to become a successful engineer, including the skills required to rapidly become familiar with new developments, while a more specialist course may neglect some of these topics in order to cover the more specialist subjects. This can be an advantage for those wanting to follow a career in the particular specialization, but if you do not know which specialization would suit you best, then a more general course may be more appropriate.

Fortunately, many courses begin by covering general electronic engineering, but allow specialization in later stages of the course. A typical course may be fairly general for the first two years, with specialization available in the third and fourth years. While following a joint course will give additional skills, it will allow less time for the core electronics knowledge, and so choosing an unrelated subject can leave the graduate not fully qualified in either of the subjects contributing to the degree.

Quality courses

Besides deciding which type of course would suit you best, it is important to choose the right university. Each university sets its own curriculum, decides the teaching methods that will be used, and the qualifications required for entry. The facilities available within each university, the qualifications of the staff, and the specializations available will also differ. It can be difficult to know which universities will offer the best education, especially as each institution wishes to promote its own courses. Although the reputation of a university may give an indication of the quality of education, the fact that they have a good reputation does not necessarily mean that the electronic engineering course will be equally good. Similarly, some of the best universities for the study of electronics are not generally recognized.

In order to help choose a suitable course, there are a number of sources of independent information. The British Government established the Quality Assurance Agency to assess the quality of education provided by each university in particular subjects. In order to make these assessments, a panel of experts visit the university to observe teaching, talk to students, graduates, and their employers. They then award a grade out of 24 points. The panel also produce a report covering each of the six areas of the assessment. The assessments for electronic engineering, involving 76 institutions, were carried out between 1996 and 1998. The reports on each institution are publicly available on the QAA website: *www.qaa.ac.uk*.

A total of ten universities gained the maximum possible grade (24 out of 24), but it is important to look at the individual reports, since these specify what the courses aim to achieve. The assessment is a judgement of how well these aims are achieved.

A second factor to consider in quality of courses is accreditation by professional bodies. In the case of electronic engineering, this is the Institution of Electrical Engineers (IEE). The IEE looks at both the subject matter and the way it is taught, and can award accreditation for three different levels of course. Accredited Master of Engineering (MEng) and Bachelor of Engineering (BEng) honours courses lead eventually to chartered engineer status, while other degree courses can lead to Incorporated Engineer status. Although accreditation of a course means that it has met the required standard, if a course is not accredited, this does not necessarily mean that it is not a good course. A course can only be fully accredited once students have graduated, and so it may take four to five years before a new course can be accredited. Courses that address new technologies may be very relevant to industry, but because they are new, they may not be accredited. Courses that combine electronics with other disciplines may also not be accredited because they do not contain sufficient core electronic engineering material, but this does not mean they are not worth considering if the subject is what you want to study.

The choice of whether to study a MEng or BEng (honours) course can be a difficult one. MEng courses tend to last four years, while BEng's are generally one year shorter. This does save money on fees and living expenses, but if your eventual aim is to gain chartered status, a further year of academic study is required following graduation from a BEng.

Your choice of university may also take account of the cost of living. This can vary a great deal depending on the location of the university. Although London, for example, has many attractions for students, the costs of accommodation, transport, and food all tend to be higher than in other parts of the country. Worrying about money and the need to work can be a big distraction from your academic work.

With the choice of different subjects, course structures, and universities open to students of electronic engineering, it can seem overwhelming. You should try to decide what you really want to get out of your course. Then look for independent information, try to talk to someone who has studied at the universities you are interested in and, if you are unsure about what a particular course involves, or whether a particular university would suit you, then contact the Department with your questions. You will be able to learn a lot from the way they answer, both about the courses and the way that they treat students.

Author: Dr Jim Gilbert, School of Engineering, University of Hull

***Why electrical engineering*?**

Take a minute to imagine life without electricity. A lot of things that we take for granted would change out of all recognition. The basics of light, heat, and transport would be provided by other sources of power, but would they be as user-friendly?

Imagine what life could be like in fifty years time if we were able to capitalize on the full potential of electricity in all of its guises. Control over the environment, instantaneous communications, more friendly computers able to provide information on and solutions for our everyday problems. If you can imagine life without electricity, electronic devices, and computers, you will quickly appreciate the importance of electricity to virtually everybody.

The electrical engineering industry of the United Kingdom, which includes all aspects of electrical power systems, electrical drives, electronics, computer systems, communications, etc., has always taken an international viewpoint. In part, this can be traced to the colonial era, but in the main, it is an acceptance that the United Kingdom is in itself a small market and that there is greater satisfaction and reward to be had through servicing the wider global market.

Historically, UK engineering can demonstrate its application in almost every part of the world. As new geographical areas of engineering expertise have developed, these have often been in collaboration with British engineers, as the UK provides one of the largest concentrations of consulting engineers operating anywhere and everywhere. One of the roles of the engineering community is to provide the facilities to educate those choosing the profession. These young engineers can then provide the systems that society wants, be it to make life easier, more productive, more satisfying, or simply more enjoyable.

Worldwide recognition

In the United Kingdom, these facilities have been developed over several centuries, and have lead to both a wide spectrum of professional bodies and a powerful education system designed to satisfy the ever-changing and ever-demanding needs of the engineering community. The excellence of UK universities and their technical prowess are recognized worldwide, providing the full spectrum of education required for those needing to run and maintain the systems of today, and for those who must undertake the research and development to provide the understanding and systems for tomorrow.

The need to develop people able to work beyond the limits of current knowledge and to cultivate a medium and long-term perspective has led to well-established research education programmes leading to Master's and Doctorate degrees. The premise for UK universities is that the most effective method of research learning is achieved by working in the field, and that the best educators are experts practising their subject. The academic staff in electrical engineering departments of UK universities are invariably engineers, and most are heavily engaged in state-of-the-art research.

Students are given access to this work at a variety of points in the educational process. Taught degrees will invariably include a project, many of which consist of elements of the supervisor's research work. Research degrees, either at Master's or Doctorate level, will be based on exploring a new area of study, allowing students the opportunity to learn the disciplines of the research world as well as making a personal contribution to the field. For their Doctorate, the student is expected to make a unique contribution.

Electrical engineering in all its guises is both essential for the future and rewarding for those involved. Opportunities abound for those interested in getting involved, and the spectrum of activities ensures that personal satisfaction is guaranteed.

Author: Dr Miles A. Redfurn, University of Bath

8. CAREERS IN MECHANICAL ENGINEERING

(http://www.science-engineering.net)

What is mechanical engineering?

Engineering affects every aspect of human activity—work, leisure, health, and education. Engineers are involved in the design and manufacture of almost everything, from cars to computers, from web pages to wings, from microchips to motorways. Many recent medical advances have been made as a result of work done by engineers, ranging from brain scanners to the drug dispensers used by asthma sufferers.

Training as a mechanical engineer will lead you into one of the broadest areas of engineering. There are jobs for mechanical engineers in nearly every area of industry. As a mechanical engineer you could become involved in design, manufacture, research, development, management, or marketing.

Mechanical engineers are expected to constantly improve, re-design and invent equipment, not just maintain and process. There have been a multitude of mechanical engineering advancements that don't make the headlines that are crucial to our everyday lives, making them easier, faster, and more efficient. A recent, well-known project is the London Eye—the massive mechanical marvel by the river Thames. Mechanical engineering played a vital part in the design, manufacture, and installation of the Eye, something that was originally believed to be impossible. Now it is both an extremely popular tourist attraction and an inspiration to future engineers.

Other examples include medical engineering companies now developing surgical robotic systems for orthopaedic, spinal, and dental surgery. Environmental engineers in the UK are producing world-leading technology in emission control, while UK-based mechanical engineers in the defence industry are creating an innovative protection system for the International Space Station, amongst other things. This is just a selection of the exciting, innovative, and challenging projects that mechanical engineers are involved in.

There is a shortage of engineers the UK, therefore there are excellent job prospects for mechanical engineers, and currently 70% of graduates go into full-time careers associated with engineering.

Qualifications

Standards for education, training, and professional development of all engineers in the UK have been considerably revised in recent years to ensure qualifications remain on a par with the best internationally, and that they also meet the changing needs of commercial and industrial markets. Today the focus is very much on gaining practical experience as well as academic achievements.

The entry requirement for mechanical engineering degree courses is normally three high grade "A" levels (now A2) in maths, physics, or physical sciences and one other subject. Five GCSE/S grades at grade C or above including maths and English and in most cases a science subject will also be required.

Which course/university?

There are many universities offering degrees in mechanical engineering and there is a wide variation in the types of courses and specialisms offered within these degrees, so it is a good idea to check the prospectuses carefully before applying. It is possible to do joint honours with a range of other subjects both sciences and arts including business and language courses. It is important that you ensure that your degree is an accredited course recognized by the Institute of Mechanical Engineers. There are three-year courses, which are full-time and usually lead to a BEng qualification. There are also four-year courses leading to a MEng qualification. In order to become chartered you need to have completed at least four years of academic study.

If you take a BEng degree, it is possible to add a further year of specialized study known as a Matching Section. There are also sandwich courses available that include a year spent in industry gaining practical work experience. In order to become a chartered mechanical engineer you need to spend a period of time gaining approved work experience after graduating known as Initial Professional Development (IPD). This usually lasts for at least four years, after which you can apply to become chartered.

For a list of UK universities running mechanical engineering courses, log on to the UCAS website: *www.ucas.co.uk*. A list of IMechE accredited courses can be found at: *www.imeche.org.uk/profdev/degree_accreditation.htm*.

Earnings potential

Graduates should expect to earn in the region of £18,000+. This can rise to £40,000 and above with experience.

Finding a job in engineering

Many jobs are still obtained through the traditional method of advertising—in papers, on the Internet, in careers publications, etc. *Professional Engineering*, the publication produced by Professional Engineering Publishing, offers on average 40 pages of engineering advertisements per fortnightly issue, the details are also found on their website: *www.professionalcareers.net*. The IMechE also produces *Engineering Opportunities*—an annual publication targeted at students and graduates, which lists companies offering employment and training programmes.

Career benefits

The mechanical engineering professional can, and should, aim high in their career aspirations. The recent Engineering Council report identifies that engineers and scientists hold more than quarter of leading executive positions in FTSE 100 companies (as of 3 December 2001).

Here to help you

The IMechE is here to help you. At each university running IMechE accredited degrees there is an Academic Liaison Officer (ALO). They are there to help you with your questions, to give advice & provide knowledge. To find out who the ALO is at your chosen university, email: education@imeche.org.uk. For further information about membership of the IMechE, please, contact the Membership department, tel: 0845 226 9191, email: membership@imeche.org.uk.

Why study mechanical engineering

The UK education system is respected as among the best in the world, home to arguably two of the most famous universities, and a number of world-class centres of learning. Britain itself is the world's fourth largest economy, with a diverse culture where differences are celebrated.

Mechanical engineering courses in British universities offer the highest quality teaching and research and, once qualified, mechanical engineers are among the most sought-after, and highly paid, professionals in UK business.

What will the course offer?

Mechanical engineering is specifically concerned with design, development, installation, operation, and maintenance of just about anything that has moveable parts. As a result, there are job opportunities for mechanical engineers in practically every field of work, transport, health, defence, manufacturing, entertainment, finance, publishing, building, design, and research, to name but a few. Mechanical engineering projects can range from designing heart valves and artificial limbs, clockwork radios and dentists' drills to building racing cars, jet engines, or space modules.

A career in mechanical engineering would suit a "behind the scenes" or "in front of the camera" type person. The only pre-requisites are high academic qualifications along with a passion for learning and enthusiasm for making things happen.

How to choose the right course and university

Mechanical engineering courses vary widely in content, assessment, and teaching. Deciding which course to do is no easy task, but your choice can ensure your future career prospects are met. The basic mechanical engineering degree course includes certain core subjects—communication, drawing and computer-aided design (CAD) and engineering, control, electrical machines and power, fluid mechanics, materials, stress analysis, thermodynamics and heat transfer, dynamics and vibration, electronics, manufacturing systems, measurement and instrumentation, statics and structures. Courses can also cover a number of other non-mandatory subjects, for example, business management, accountancy, and IT. Contact your college careers office for further advice and information.

Career benefits

A mechanical engineering degree places graduates ahead in the race for quality employment. Statistics show that mechanical engineers earn lots of money! In a recent study by the Engineering Council, engineering graduates were found to be earning a median of £24,000 per annum—that's 19% more than the average for all graduates three and a half years after graduation.

The mechanical engineering professional can, and should, aim high in their career aspirations. There is an underlying myth around the profession that the realm of engineers is in "middle management". This myth has always been disputed, and has been disproved in the same ETB report. The report identifies that engineers and scientists hold more than quarter of leading executive positions in FTSE 100 companies (as at 3 December 2001). And, due to the declining number of mechanical engineering graduates entering the profession, there is an abundance of job opportunities in a variety of industries.

The percentage of women joining the engineering profession is rising each year, yet still only account for 15% of the entire professional engineering workforce. For those that do, there is more good news. Recent statistics have proven that women in engineering are actually ahead of their male counterparts where salary is concerned! A recent survey by EMTA (the National Training Organisation for Engineering Manufacture) reports that senior female engineer earns 8.5% more than male colleagues, rising to 11.9% by the time she reaches her early 40s.

Incentives from the Institution of Mechanical Engineers (IMechE)

It is a goal of the IMechE to actively seek, educate, and inform society of the benefits of mechanical engineering. For IMechE members registered on an accredited mechanical engineering course in the UK, there are a number of financial incentives (very important to students!) to make life at university financially easier. These range from undergraduate development funds, overseas study awards, hardship awards, Third World project awards, postgraduate development funds, and research awards. For more information about the awards, please, contact Karen Frost, IMechE Awards Officer, on tel: +44 1284 718 617.

Recent innovations

Thousands of years ago "mechanical engineers" invented the wheel. Today's mechanical engineers have created the London Eye—the most modern and advanced wheel of the 21st century. Anyone who lives in, has visited or has read about London, will be aware of the major new attraction in the heart of the capital. The London Eye is a massive mechanical marvel that lives by the river Thames. Mechanical engineering played a vital part in the design, manufacture, and installation of the Eye, something that was originally believed to be impossible. Now it is both an extremely popular tourist attraction and an inspiration to future engineers.

In the past year there has been a lot of media attention surrounding the new Virgin Pendolino train (derived from the word pendulum) which swings in and out of bends, smoothing the journey for passengers at high speeds. The Pendolinos will be able to travel at up to 140 miles an hour, compared with current speeds of around 110 mph. Residents in the UK are due to benefit from this mechanical engineering advancement later in 2002.

There are a multitude of mechanical engineering advancements that don't make the headlines but are crucial to our everyday lives, making them easier, faster, and more efficient. For example, medical engineering companies are now developing surgical robotic systems for orthopaedic, spinal, and dental surgery. Environmental engineers in the UK are producing world-leading technology in emission control. UK-based mechanical engineers in the defence industry are creating an innovative protection system for the International Space Station, among other things. This describes just a few of the exciting, innovative, and challenging projects that mechanical engineers are involved in.

Here to help you

One of the original strategic aims of the Institution was to be the leading forum for the exchange of knowledge and expertise in the field of mechanical engineering. That is still what we strive to achieve today. The IMechE is here to help you.

A mechanical engineering degree is just the beginning. Most engineering students aspire to achieve chartered status (CEng), which is the highest professional engineering qualification. The IMechE is your route to chartered status as a mechanical engineer, and to worldwide recognition as a qualified engineer.

For further information about the possibilities for studying engineering in the UK and a career in mechanical engineering, call one of the friendly, knowledgeable staff on 0845 226 9191, or email: *membership@imeche.org.uk*, or take a look at the website: *www.imeche.org.uk*.

Author: Sara Richardson, Institution for Mechanical Engineers

9. HOW UNIVERSITY CAN BENEFIT YOUNG PEOPLE

(adapted from: http://www.science-engineering.net)
The original text was written by Margaret Hodge, Lifelong Learning and Higher Education Minister

In the early sixties, in the UK only one in twenty school leavers went to university. Today it is one in three. More adults are taking a degree in their twenties too.

Britain needs more people with degrees and more skilled workers with higher technician and associate professional qualifications in the years ahead. Over the next 10 years most of the new jobs will need people who have the skills and education higher education offers. That's why the Government wants half of all young people under 30 to experience the benefits of higher education.

But getting a degree not only boosts your education and skills, it improves your ability to earn a good living too. Graduates earn on average of 35 per cent more than the average wage—or £400,000 more over a lifetime than somebody on average earnings.

There may be different reasons why some of students who have the potential to benefit from university feel it is not for them. Sometimes it is because nobody in their family or in their street has been to university. For others, it may be worries about how much it will cost—and finding the fees.

But there's a lot more help available than one might think. And the aim of the Ministry of education of Great Britain is to talk to young people about the benefits of higher education and the support on offer to them.

There are plenty of different courses, which can help the youngsters to make the most of themselves. Many young people decide to go to work after school or college, and go on to university a bit later on. In fact, a third of all undergraduates are not school leavers. There are many full and part-time courses and most universities have particular programmes designed to support mature students.

The government has also introduced new vocational foundation degrees. In areas like applied engineering, hotel management and multimedia technology, they will help students get promoted and lead to better jobs.

Anyway, university degree is good value for money. Extra learning does lead to extra earnings. And there's already lots of help available while young people study.

10. IS HIGHER EDUCATION FOR YOU?

(adapted from: http://www.science-engineering.net)

The UK has more than 250 universities or specialist colleges offering over 40,000 higher education programmes. These are mainly degree and higher national diploma courses and are, to a large extent, what you go on to after school or FE college, aged around 17 to 19 and armed with A levels, GNVQ, Scottish Highers, or some other equivalent. You can, however, leave it for a while and return to higher education later in your life.

Our economy needs more graduates and has invested massively in expanding the number and range of higher education courses. But it is so difficult to make the right choice! If you decide that higher education is for you—and it is a very sensible choice for a lot of bright people—make sure that you take the time and trouble to find a course and a university that match your personal requirements.

Remember: higher education can be (and usually is) one of the most exciting, rewarding, and valuable periods of your life—but it is vital to do your research first!

Navigate the system. Get a feel of what is available and where. Why should you follow one course rather than another? Do you want to train for a specific career? Do you want to be on the coast or in a big city centre?

Ask questions. And when you have the answers you need, ask more questions. An enquiring mind is a priceless asset! Use the web, e-mail, phone, fax... you could even go and talk to people face to face. Ask those around you: family, friends, teachers, careers advisers and so on. If you don't ask, you may never know.

Search. All universities have websites. All produce glossy prospectuses. Other people produce software and books containing valuable data. Search. Sift. Compare. Choose.

Apply. Most higher education providers in the UK—apart from the Open University—are part of the UCAS centralized applications system. You can apply on old-style paper or you can do it all electronically.

Ask questions! Before you choose a university!

Ask yourself—and anyone else whose opinion you value— the following questions:

1. Do I have a particular career in mind?
2. Am I seeking a higher education qualification as a requirement for initial entry to a specific profession?
3. Do I just want to chill out for a while, maturing gradually and developing my thought processes?
4. Is there a specific subject I want to explore thoroughly?
5. Do I want to develop my key skills?
6. Do I want to make myself generally more employable?

7. Do I want a clean break from my present circumstances and the chance to make a fresh start?
8. Do I want to study full-time/part-time/by distance learning, at home/away from home?
9. Can I afford it?
10. What are the alternatives?

These are not the sort of questions that have simple right or wrong answers. In fact, an answer which may appear right now might well look wrong (and vice versa!) when your personal circumstances change in, say, 10 years time. All you can hope to do is gather all the available evidence, weigh up all the pros and cons, and make the decision which best relates to your current priorities and circumstances.

Student life

Student life can be very rewarding, but it can also have its pitfalls.

Student Action Plan

If you are on the brink of choosing a degree course, this Action Plan will help you to make the most of your university years, even if you are not yet sure of your career.

In the future you will need the skills to manage a varied career and to be an effective learner. These are the skills which will allow you to develop and make use of your own individual strengths. They could easily be called “enabling skills” because they will enable you to be effective in managing your work and its relationship with the rest of life. They will put you in charge, instead of being at the mercy of your work.

The task is not impossible. There are simple things you can do to develop these self-reliance skills. The Action Plan lists a number of things suggested by employers and academics, which can be done to make the most of the opportunities which exist at university to develop these skills.

1. Increase your self-awareness

List your strengths and weaknesses. Use others to help. Continually update the list.

Actively seek feedback from colleagues, staff, close friends, and family. Get outside your comfort zone!

Notice which experiences really motivate you. Write them down. Make an effort to establish your values and underlying beliefs. You will not be comfortable if you do things which work against these values.

2. Make an informed decision about what, how and where to study.

In a Guardian/Gallup survey of recent graduates, 30% said they would probably not take the same course if they had their time over again.

Think about your reasons for doing a degree

Can you define exactly what you will gain from a degree? Is it the best option? Is now the right time? Is a full time or part time course best? If you are a sixth-form student, should you take a year out? A degree can be immensely rewarding, but you need to have a clear idea of what you will gain from it. If possible, think about what you would like to be doing in five or ten years' time, and plan accordingly.

Get to know your preferred learning style

How do you learn best? Alone or in groups? In the morning or evening? Via computer? With unstructured challenges or set questions? Do you prefer books, lectures, projects, home study, essays? Do you prefer an academic or vocational approach? What motivates you? These questions need to be answered before you can make an informed decision about where to study.

Ask universities some searching questions

This is vital. If necessary, show them the checklist on the back of this Action Plan so you don't appear too pushy.

3. Gain relevant work experience

This could be through vacation work, gap year work, sponsorship through university or by choosing a sandwich course. Any work experience is useful. Customer-facing work is especially good.

If you can't get paid work, voluntary work is always available and can be just as useful.

If you already have some work experience, try to make your next job more focused on your intended career.

Use family and friends first to find work. They are contacts you already have.

Small business experience is good. You may be given more responsibility, and there may be a wider variety of jobs to be done.

Spend occasional days work shadowing family and friends. This will help you explore many more options.

Think about what you have to offer your employer. This will enable you to "sell yourself" more effectively.

4. Develop skills for the workplace

They may be developed through the curriculum or in outside activities such as university clubs and societies.

Become involved in teams.

Take responsibility and initiative. Start something new, and lead it to completion.

Make different kinds of presentations to different kinds of audiences, including factual and persuasive presentations and, if possible, one to an audience hostile to your case.

Make the most of opportunities to travel. Practise a language. Take an interest in the local culture, even the economy or politics. Don't just sit on the beach!

5. Set aside opportunities to reflect on your learning

Use a learning log. Employers always look for evidence of skills learned. Seek support from colleagues.

Learn from both successes and failures. If an experience is painful, turn it into something positive by learning from it. Recognize your own reaction to failures and disappointments, so you can cope better in the future.

6. Use your contacts: develop the art of networking

Start with family and friends. They are an easily forgotten resource. Draw up a list of those who might be able to support you in your decisions or help you find vacation work.

When networking, ask people for advice. They are usually willing. Also ask them whether they know other people who might be able to help, and whether you can mention their name. Your network will expand, and all kinds of help may result.

7. Explore options

Don't sit in an academic oxygen bubble. Read a newspaper. Talk to people (questioning, listening, recording). Visit the careers service to look for vacation work. Use AIESEC and Student Industrial Society networks at university. Find out about the changing graduate job market. Visit careers fairs in the first or second year.

Turn research into action. Be proactive. Set objectives and do some "action planning".

Make the most of your final year project. It can be a route into employment.

8. Practise negotiation skills

Negotiations occur all the time. Practise negotiation skills and recognize all the opportunities to develop them in everyday life. Recognize that negotiation within a long-term relationship should aim for a "win/win" outcome.

9. Do something different

What will make you different from the other thousands of graduates? Perhaps you could learn an unusual language, take up a distinctive hobby or set up a new voluntary organization.

10. Don't panic! You don't have to be perfect

Tackle this Action Plan in manageable chunks and review your progress regularly. You will find you can achieve a great deal over three or four years if you start now.

Degree course checklist

When choosing a degree, ask universities some searching questions. Try to discover the answers to the questions below. If necessary, show them this checklist.

1. How do staff gather student feedback on the course, and how do they respond to it?

2. Do the staff have a clear idea of the skills which students develop as part of the course, in addition to subject knowledge?
3. What teaching methods are used to help students develop these skills?
4. How are staff teaching skills developed?
5. Is there evidence that the staff work together as a team? For example, has the course been developed as a team or by individuals?
6. How are students encouraged to develop their learning skills? For example, do they encourage “learning logs” to help students reflect on their learning?
7. Is there any employer input in the way the course is taught?
8. Is it possible to meet graduates who are now working, and can comment on the value of the course?
9. What is the “dropout rate” for the course, and what are the reasons people leave?
10. What kind of learning environment do they offer? Find out about teaching styles, projects, working in teams, work timetable, the kind of students, access to staff support (e.g. tutors) and the level of structure or independence, and then see how the course will match your preferred learning style.

11. PROPERTIES OF MATERIALS (1)

A material’s property is an intensive, often quantitative property of a material, usually with a unit that may be used as a metric of value to compare the benefits of one material versus another to aid in materials selection.

A material property may be a constant or may be a function of one or more independent variables, such as temperature. Material’s properties often vary to some degree according to the direction in the material in which they are measured; a condition referred to as anisotropy. Materials properties that relate two different physical phenomena often behave linearly or approximately so in a given operating range and may then be modeled as a constant for that range. This linearization can significantly simplify the differential constitutive equations that the property describes.

Some material's properties are used in relevant equations to determine the attributes of a system a priori. For example, if a material of a known specific heat gains or loses a known amount of heat, the temperature change of that material can be determined. Materials properties may be determined by standardized test methods. Many such test methods have been documented by their respective user communities and published through ASTM International.

12. PROPERTIES OF MATERIALS (2)

Iron is a metallic chemical element with the symbol **Fe** (Latin: *ferrum*) and atomic number 26. Iron is a group 8 and period 4 element and is therefore classified as a transition metal. Iron and iron alloys (steels) are the most common metals and the most common ferromagnetic materials in everyday use. Pure iron is a metal but is rarely found in this form on the surface of the earth because it oxidizes in the presence of oxygen and moisture. Fresh iron surfaces are silvery-gray in color, but oxidize in air to form a red or brown coating of ferric oxide or rust. Pure single crystals of iron are soft (softer than aluminum). The properties of iron can be modified by alloying it with various other metals to form steels. Alloying iron with appropriate small amounts (up to a few per cent) of other metals produces steel which can be 1,000 times harder than pure iron. Iron is a necessary element used by almost all living organisms.

Glass is an amorphous (non-crystalline) solid material. Glass breaks easily, and is often optically transparent. Glass is commonly used for windows, bottles, modern hard drives, eyewear, etc. The word *glass* developed in the late Roman Empire. It was in the Roman glassmaking center at Trier, now in modern Germany, that the late-Latin word *glesum* referred to a transparent substance. Glass plays an important role in science and industry. The optical and physical properties of glass make it suitable for applications such as flat glass, container glass, optics and optoelectronics material, laboratory equipment, etc.

Plastic is the general common term for a wide range of synthetic or semisynthetic organic amorphous solid materials used in the manufacture of industrial products. Plastics are typically polymers of high molecular mass, and may contain other substances to improve production, the quality of products and/or reduce costs. Monomers of plastic are either natural or synthetic organic compounds.

The word is derived from the Greek πλαστικός (plastikos) meaning “suitable for moulding”, and πλαστός (plastos) meaning “molded”. It refers to their plasticity during manufacture, that allows them to be pressed, or shaped into a variety of forms—such as films, fibers, plates, tubes, bottles, boxes, and much more.

The common word *plastic* should not be confused with the technical adjective *plastic*, which is applied to any material which undergoes a permanent change of shape (plastic deformation) when strained beyond a certain point. Aluminum, for instance, is plastic in this sense, but not a plastic in the common sense; in contrast, in their finished forms, some plastics will break before deforming and therefore are not plastic in the technical sense.

There are two types of plastics: thermoplastics and thermosetting polymers. Thermoplastics will soften and melt if enough heat is applied; examples are polyethylene, polystyrene, polyvinyl chloride, and polytetrafluoroethylene (PTFE). Thermosets can melt and take shape once.

Plastics can be classified by chemical structure. Some important groups in these classifications are the acrylics, polyesters, silicones, polyurethanes, and halogenated plastics. Plastics can also be classified by the chemical process used in their synthesis, such as condensation, polyaddition, and cross-linking.

Other classifications are based on qualities that are relevant for manufacturing or product design. Examples of such classes are the thermoplastic and thermoset, elastomer, structural, biodegradable, and electrically conductive. Plastics can also be classified by various physical properties, such as density, tensile strength, glass transition temperature, and resistance to various chemical products.

Due to their relatively low cost, ease of manufacture, versatility, and imperviousness to water, plastics are used in an enormous and expanding range of products, from paper clips to spaceships. They have already displaced many traditional materials, such as wood, stone, horn and bone, leather, paper, metal, glass, and ceramic, in most of their former uses.

The use of plastics is constrained chiefly by their organic chemistry, which seriously limits their hardness, density, and their ability to resist heat, organic solvents, oxidation, and ionizing radiation. In particular, most plastics will melt or decompose when heated to a few hundred degrees Celsius. While plastics can be made electrically conductive to some extent, they are still no match for metals like copper or aluminum. Plastics are still too expensive to replace wood, items like ordinary buildings, bridges, dams, pavement, and railroad ties.

The first human-made plastic was invented by Alexander Parkes in 1855; he called this plastic Parkesine (later called celluloid). It was demonstrated at the 1862 Great International Exhibition in London. The development of plastics has come from the use of natural plastic materials (e.g. chewing gum, shellac) to the use of chemically modified natural materials (e.g. rubber, nitrocellulose, collagen, galalite) and finally to completely synthetic molecules (e.g. bakelite, epoxy, polyvinyl chloride, polyethylene).

A **metal** is a chemical element that is a good conductor of both electricity and heat. In chemistry, a metal (Ancient Greek *métallon*, μέταλλον) is an element, compound, or alloy that conducts electricity. In a metal, atoms readily lose electrons to form positive ions. Those ions are surrounded by delocalized electrons, which are responsible for the conductivity.

Metals occupy most of the periodic table, while non-metallic elements can only be found on the right-hand-side of the Periodic Table of the Elements. A diagonal line drawn from boron (B) to polonium (Po) separates the metals from the non-metals. Most elements on this line are metalloids, sometimes called semiconductors. This is due to the fact that these elements have electrical properties common to both conductors and insulators. Elements to the lower left of this division line are called metals, while elements to the upper right of the division line are called non-metals.

Metals are very corrosive—they rust in contact with water. Painting (or any other form of covering) is a good way to prevent their corrosion.

Metals in general have high electrical conductivity, the ability to be deformed under stress. Optically speaking, metals are opaque, shiny, and lustrous. The large number of free electrons in any typical metallic solid (element or alloy) is responsible for the fact that they can never be categorized as transparent materials.

An **alloy** is a mixture of two or more elements in which the major component is a metal. Most pure metals are too soft or chemically reactive for practical use. Combining different ratios of metals as alloys modifies the properties of pure metals to produce desirable characteristics. The aim of making alloys is generally to make them less brittle, harder, resistant to corrosion, or have a more desirable color. Of all the metallic alloys in use today, the alloys of iron (steel, stainless steel, cast iron, tool steel, alloy steel) make up the largest proportion both by quantity and commercial value. Iron alloyed with various proportions of carbon gives low, mid, and high carbon steels. The addition of silicon will produce cast irons.

Other significant metallic alloys are those of aluminum, titanium, copper, and magnesium. Copper alloys have been known since prehistory—bronze gave the Bronze Age its name—and have many applications today, most importantly in electrical wiring. The alloys of the other three metals have been developed relatively recently; due to their chemical reactivity they require electrolytic extraction processes. The alloys of aluminum, titanium, and magnesium are valued for their high strength-to-weight ratios; magnesium can also provide electromagnetic protection. These materials are ideal for situations where high strength-to-weight ratio is more important than material cost, such as in aerospace and some automotive applications.

Alloys specially designed for highly-demanding applications, such as jet engines, may contain more than ten elements.

Brass is an alloy of copper and zinc. The proportions of zinc and copper can be varied; this creates a range of brasses with various properties. In comparison, bronze is principally an alloy of copper and tin. Brass is a substitutional alloy. It is used for decoration for its bright gold-like appearance; for applications where low friction is required such as locks, gears, bearings, doorknobs, ammunition, and valves; for plumbing and electrical applications; and extensively in musical instruments such as horns and bells for its acoustic properties. It is also used in zippers. Because it is softer than most other metals in general use, brass is often used in situations where it is important that sparks not be struck, as in fittings and tools around explosive gases.

Brass has a yellow color, somewhat similar to gold. It is relatively resistant to tarnishing, and is often used as decoration and for coins. In antiquity, polished brass was often used as a mirror.

Forms of brass have been in use since prehistory. But the direct alloying of copper and zinc metal was introduced to Europe in the 16th century.

Brass has good malleability and acoustic properties. It is used in many musical instruments, such as trombone, tuba, trumpet, cornet, euphonium, tenor horn, and the French horn. Even though the saxophone is classified as a woodwind instrument and the harmonica is a free reed aerophone, both are also often made from brass. In organ pipes of the reed family, brass strips (called tongues) are used as the reeds, which beat against the shallot (or beat “through” the shallot in the case of a “free” reed).

Brass has higher malleability than copper or zinc. The relatively low melting point of brass (900 to 940°C, depending on composition) and its flow characteristics make it a relatively easy material to shape. By varying the proportions of copper and zinc, the properties of the brass can be changed, allowing hard and soft brasses.

Today almost 90% of all brass alloys are recycled.

Aluminum makes brass stronger and more corrosion resistant. Aluminum also causes a highly beneficial hard layer of aluminum oxide (Al_2O_3) to be formed on the surface that is thin, transparent, and self-healing. Tin has a similar effect and finds its use especially in sea water applications (naval brasses). Combinations of iron, aluminum, silicon, and manganese make brass wear and tear resistant.

Diamond (from the Ancient Greek αδάμας—adámas “unbreakable”) is an allotrope of carbon. Diamond is less stable than graphite, but the conversion rate from diamond to graphite is negligible at ambient conditions. Diamond has the highest hardness and thermal conductivity of any bulk material. Those properties determine the major industrial application of diamond in cutting and polishing tools.

Diamond has remarkable optical characteristics. Combined with wide transparency, this results in the clear, colorless appearance of most natural diamonds. Diamond also has relatively high optical dispersion, that is ability to disperse light of different colors, which results in its characteristic luster. Excellent optical and mechanical properties, combined with efficient marketing, make diamond the most popular gemstone.

Diamond is the hardest natural material known, where hardness is defined as resistance to scratching and is graded between 1 (softest) and 10 (hardest) using the Mohs scale of mineral hardness. Diamond has a hardness of 10 (hardest) on this scale. Diamond's hardness has been known since antiquity, and is the source of its name.

Diamond hardness depends on its purity. The hardness of diamond contributes to its suitability as a gemstone. Because it can only be scratched by other diamonds, it maintains its polish extremely well. Unlike many other gems, it is well-suited to daily wear because of its resistance to scratching—perhaps contributing to its popularity as the preferred gem in engagement or wedding rings, which are often worn every day.

Other specialized applications also exist or are being developed, including use as semiconductors: some blue diamonds are natural semiconductors, in contrast to most diamonds, which are excellent electrical insulators.

Cement is a substance which can be mixed with water and become hard after drying. The term *cement* refers only to the dry powder substance. After the addition of water the cement mixture is referred to as "concrete". Cement (mixed with water) can join other materials together.

The word "cement" traces to the Romans, who used the term "*opus caementicium*" to describe construction which was made from crushed rock with burnt lime as binder. Cements used in construction are characterized as hydraulic or non-hydraulic.

The most important use of cement is the production of a strong building material.

13. ALLOYS

An alloy is a mixture of two or more elements in solid solution in which the major component is a metal. Most pure metals are either too soft, brittle or chemically reactive for practical use. Combining different ratios of metals as alloys modifies the properties of pure metals to produce desirable characteristics. The aim of making alloys is generally to make them less brittle, harder, resistant to corrosion, or have a more desirable color and luster. Of all the metallic alloys in use today, the alloys of iron (steel, stainless steel, cast iron, tool steel, alloy steel) make up the largest proportion both by quantity and commercial value. Iron alloyed with various proportions of carbon gives low, mid, and high carbon steels, with increasing carbon levels reducing ductility and toughness. The addition of silicon will produce cast irons, while the addition of chromium, nickel, and molybdenum to carbon steels (more than 10%) results in stainless steels.

Other significant metallic alloys are those of aluminum, titanium, copper, and magnesium. Copper alloys have been known since prehistory—bronze gave the Bronze Age its name—and have many applications today, most importantly in electrical wiring. The alloys of the other three metals have been developed relatively recently; due to their chemical reactivity they require electrolytic extraction processes. The alloys of aluminum, titanium, and magnesium are valued for their high strength-to-weight ratios; magnesium can also provide electromagnetic shielding. These materials are ideal for situations where high strength-to-weight ratio is more important than material cost, such as in aerospace and some automotive applications.

Alloys specially designed for highly-demanding applications, such as jet engines, may contain more than ten elements.

14. COMPUTER USAGE IN ENGINEERING

As with all modern scientific and technological inventions, computers and software play a very important role. There are a number of computer-aided applications (computer-aided technologies) specifically for engineering. Computers can be used to generate models of fundamental physical processes, which can be solved using numerical methods.

One of the most widely used tools in the profession is computer-aided design (CAD) software which enables engineers to create 3D models, 2D drawings, and schematics of their designs. CAD together with Digital mockup (DMU) and CAE software such as finite element method analysis or analytic element method allows engineers to create models of designs that can be analyzed without having to make expensive and time-consuming physical prototypes.

These allow products and components to be checked for flaws; assess fit and assembly; study ergonomics; and to analyze static and dynamic characteristics of systems such as stresses, temperatures, electromagnetic emissions, electrical currents and voltages, digital logic levels, fluid flows, and kinematics. Access and distribution of all this information is generally organized with the use of Product Data Management software.

There are also many tools to support specific engineering tasks such as computer-aided manufacture (CAM) software to generate CNC machining instructions; Manufacturing Process Management software for production engineering; EDA for printed circuit board (PCB) and circuit schematics for electronic engineers; MRO applications for maintenance management; and AEC software for civil engineering.

In recent years the use of computer software to aid the development of goods has collectively come to be known as Product Lifecycle Management (PLM).

15. CANALS

Canals are human-made channels for water. There are two types of canals:

1. Aqueduct (or water conveyance) canals that are used for the conveyance and delivery of fresh water, for human consumption, agriculture, etc.
2. Waterway canals that are navigable transportation canals used for carrying ships and boats loaded with goods and people, often connected to existing lakes, rivers, or oceans. Included here are inter-ocean canals such as the Suez Canal and the Panama Canal.

The word “canal” is also used for a city-canal in cities such as Venice, Amsterdam or Bangkok.

Types of artificial waterways

Canals are created in one of three ways, or a combination of the three, depending on available water and available path:

— A canal can be created where no stream presently exists. The body of the canal is either dug or the sides are created by piling dirt, stone, concrete, or other building materials. The water for the canal must be provided from an external source like other streams or reservoirs. Examples include canals that connect valleys over a higher body of land, like Canal du Midi and Canal de Briare.

— A stream can be *canalized* to make its navigable path more predictable and easier to maneuver. Canalization modifies the stream to more safely carry traffic by controlling the flow of the stream with dredging, damming, and modifying its path. Examples include Basse Saône, Canal de Mines de Fer de la Moselle, and the Aisne River.

— When a stream is too difficult to modify with *canalization*, a second stream can be created next to the existing stream. This is called a *lateral canal*. The existing stream usually acts as the water source and its banks provide a path for the new body. Examples include Canal latéral à la Loire, Garonne latéral Canal, and Canal latéral à l’Aisne.

Smaller transportation canals can carry barges or narrowboats, while ship canals allow seagoing ships to travel to an inland port (e.g. Manchester Ship Canal), or from one sea or ocean to another (e.g. Caledonian Canal, Panama Canal).

At their simplest, canals consist of a trench (a long narrow hole that is dug in the ground for water to flow along) filled with water. Depending on the stratum the canal passes through, it may be necessary to line the cut with some form of watertight material such as clay or concrete. When this is done with clay, this is known as puddling.

Canals need to be level, and while small irregularities in the lie of the land can be dealt with through cuttings and embankments, for larger deviations, other approaches have been adopted. The most common is the pound lock which consists of a chamber within which the water level can be raised or lowered connecting either two pieces of canal at a different level or the canal with a river or the sea. When there is a hill to be climbed, flights of many locks in short succession may be used.

Prior to the development of the pound lock in 984 AD in China by Chhaio Wei-Yo and later in Europe in the 15th century, either flash locks consisting of a single gate were used or ramps, sometimes equipped with rollers, were used to change level. Flash locks were only practical where there was plenty of water available.

Locks use a lot of water, so builders have adopted other approaches. These include boat lifts, such as the Falkirk wheel, which use a caisson of water in which boats float while being moved between two levels; and inclined planes where a caisson is hauled up a steep railway.

To cross a stream or road, the solution is usually to bridge with an aqueduct. To cross a wide valley (where the journey delay caused by a flight of locks at either side would be unacceptable) the centre of the valley can be spanned by an aqueduct—a famous example in Wales is the Pontcysyllte aqueduct across the valley of the River Dee.

Another option for dealing with hills is to tunnel through them. An example of this approach is the Harecastle Tunnel on the Trent and Mersey Canal. Tunnels are only practical for smaller canals.

Some canals attempted to keep changes in level down to a minimum. These canals known as contour canals would take longer winding routes, along which the land was a uniform altitude. Other generally later canals took more direct routes requiring the use of various methods to deal with the change in level.

Canals have various features to tackle the problem of water supply. In some cases such as the Suez Canal, the canal is simply open to the sea. Where the canal is not at sea level, a number of approaches have been adopted. Taking water from existing rivers or springs was an option in some cases, sometimes supplemented by other methods to deal with seasonal variations in flow. Where such sources were unavailable, reservoirs, either separate from the canal or built into its course, and back pumping was used to provide the required water. In other cases water pumped from mines was used to feed the canal.

Where large amounts of goods are loaded or unloaded such as at the end of a canal, a canal basin may be built. This would normally be a section of water wider than the general canal. In some cases the canal basins contain wharfs and cranes to assist with movement of goods.

When a section of the canal needs to be sealed off so it can be drained for maintenance, stop planks are frequently used. These consist of planks of wood placed across the canal to form a dam. They are generally placed in preexisting grooves in the canal bank.

The oldest known canals were irrigation canals, built in Mesopotamia circa 4000 BC, in what is now modern-day Iraq and Syria. The Indus Valley Civilization in Pakistan and North India (circa 2600 BC) had sophisticated irrigation and storage systems developed, including the reservoirs built at Girnar in 3000 BC. In Egypt, canals date back at least to the time of Pepi I Meryre (reigned 2332—2283 BC), who ordered a canal built to bypass the cataract on the Nile near Aswan.

In ancient China, large canals for river transport were established as far back as the Warring States (481—221 BC), the longest one of that period being the Hong Gou (Canal of the Wild Geese), which according to the ancient historian Sima Qian connected the old states of Song, Zhang, Chen, Cai, Cao, and Wei. By far the longest canal was the Grand Canal of China, still the longest canal in the world today. It is 1,794 kilometres (1,115 mi) long and was built to carry the Emperor Yang Guang between Beijing and Hangzhou. The project began in 605 and was completed in 609, although much of the work combined older canals, the oldest section of the canal existing since at least 486 BC. Even in its narrowest urban sections it is rarely less than 30 metres (98 ft) wide.

In the Middle Ages, water transport was cheaper and faster than transport overland. This was because roads were unpaved and in poor condition and greater amounts could be transported by ship. The first artificial canal in Christian Europe was the Fossa Carolina built at the end of the 8th century under personal supervision of Charlemagne. More lasting and of more economic impact were canals like the Naviglio

Grande built between 1127 and 1257, the most important of the lombard “navigli”. Later, canals were built in the Netherlands and Flanders to drain the polders and assist the transportation of goods.

Canal building was revived in this age because of commercial expansion from the 12th century AD. River navigations were improved progressively by the use of single, or flash locks. Taking boats through these used large amounts of water leading to conflicts with watermill owners and to correct this, the pound or chamber lock first appeared, in 10th century AD in China and in Europe in 1373 in Vreeswijk, the Netherlands. Another important development was the mitre gate which was probably introduced in Italy by Bertola da Novate in the 16th century. This allowed wider gates and also removed the height restriction of guillotine locks.

To break out of the limitations caused by river valleys, the first summit level canals were developed with the Grand Canal of China in 581–617 AD whilst in Europe the first, also using single locks, was the Stecknitz Canal in Germany in 1398. The first to use pound locks was the Briare Canal connecting the Loire and Seine (1642), followed by the more ambitious Canal du Midi (1683) connecting the Atlantic to the Mediterranean. This included a staircase of eight locks at Béziers, a 157 metres (515 ft) tunnel and three major aqueducts.

Canal building progressed steadily in Germany in the 17th and 18th centuries with three great rivers, the Elbe, Oder and Weser being linked by canals. In post-Roman Britain, the first canal built appears to have been the Exeter Canal, which opened in 1563. The oldest canal built for industrial purposes in North America is Mother Brook in Dedham, MA. It was constructed in 1639 to provide water power for mills. In Russia, the Volga-Baltic Waterway, a nationwide canal system connecting the Baltic and Caspian seas via the Neva and Volga rivers, was opened in 1718.

Modern uses

Large-scale ship canals such as the Panama Canal and Suez Canal continue to operate for cargo transportation, as do European barge canals. Due to globalization, they are becoming increasingly important, resulting in expansion projects such as the Panama Canal expansion project.

The narrow early industrial canals, however, have ceased to carry significant amounts of trade and many have been abandoned to navigation, but may still be used as a system for transportation of untreated water. In some cases railways have been built along the canal route, an example being the Croydon Canal.

A movement that began in Britain and France to use the early industrial canals for pleasure boats, such as hotel barges, has spurred rehabilitation of stretches of historic canals. In some cases abandoned canals such as the Kennet and Avon Canal have been restored and are now used by pleasure boaters. In Britain canalside housing has also proven popular in recent years.

The Seine-Nord Europe Canal is being developed into a major transportation waterway, linking France with Belgium, Germany and the Netherlands.

Canals have found another use in the 21st century, as wayleaves along the towing paths for fibre optic telecommunications networks.

Canals are still used to provide water for agriculture. An extensive canal system exists within the Imperial Valley in the Southern California desert to provide irrigation to agriculture within the area.

Cities on water

Canals are so deeply identified with Venice that many canal cities have been nicknamed "the Venice of..." The city is built on marshy islands, with wooden piles supporting the buildings, so that the land is man-made rather than the waterways. The islands have a long history of settlement; by the 12th century, Venice was a powerful city state.

Amsterdam was built in a similar way, with buildings on wooden piles. It became a city around 1300.

Other cities with extensive canal networks include: Delft, Haarlem and Leiden in the Netherlands, Brugge in Flanders, Birmingham in England which has 35 miles of canals to Venice's 26 miles, Saint Petersburg in Russia, Hamburg in Germany, Fort Lauderdale, Florida, and Cape Coral, Florida in the United States.

Liverpool Maritime Mercantile City is a UNESCO World Heritage Site near the centre of Liverpool, England, where a system of intertwining waterways and docks now being developed for mainly residential and leisure use.

Canal estates are a form of subdivision popular in cities like Miami, Florida, and the Gold Coast, Queensland; the Gold Coast has over 700 km of residential canals. Wetlands are difficult areas upon which to build housing estates, so dredging part of the wetland down to a navigable channel provides fill to build up another part of the wetland above the flood level for houses. Land is built up in a finger pattern that provides a suburban street layout of waterfront housing blocks.

Inland canals have often had boats specifically built for them. An example of this is the British narrowboat, which is up to 72 feet (21.95 m) long and 7 feet (2.13 m) wide and was primarily built for British Midland canals. In this case the limiting factor was the size of the locks. This is also the limiting factor on the Panama Canal where Panamax ships are limited to a length of 294.1 m (965 ft) and a width of 32.3 m (106 ft). For the lockless Suez Canal the limiting factor for Suezmax ships is generally draft, which is limited to 16 m (52.5 ft). At the other end of the scale, tub-boat canals such as the Bude Canal were limited to boats of under 10 tons for much of their length due to the capacity of their inclined planes or boat lifts. Most canals have a limit on height imposed either by bridges or tunnels.

16. CHOICE OF TUNNELS vs. BRIDGES

For water crossings, a tunnel is generally more costly to construct than a bridge. Navigational considerations may limit the use of high bridges or drawbridge spans intersecting with shipping channels, necessitating a tunnel.

Bridges usually require a larger footprint on each shore than tunnels. In areas with expensive real estate, such as Manhattan and urban Hong Kong, this is a strong factor in tunnels' favour. Boston's Big Dig project replaced elevated roadways with a tunnel system to increase traffic capacity, hide traffic, reclaim land, redecorate, and reunite the city with the waterfront.

The 1934 Queensway Road Tunnel under the river Mersey at Liverpool, was chosen over a massively high bridge for defence reasons. It was feared aircraft could destroy a bridge in times of war. Maintenance costs of a massive bridge to allow the world's largest ships navigate under was considered higher than a tunnel. Similar conclusions were met for the 1971 Kingsway Tunnel under the river Mersey.

Examples of water-crossing tunnels built instead of bridges include the Holland Tunnel and Lincoln Tunnel between New Jersey and Manhattan in New York City, and the Elizabeth River tunnels between Norfolk and Portsmouth, Virginia, the 1934 river Mersey road Queensway Tunnel and the Westerschelde tunnel, Zeeland, the Netherlands.

Other reasons for choosing a tunnel instead of a bridge include avoiding difficulties with tides, weather, and shipping during construction (as in the 51.5-kilometre or 32.0 mi Channel Tunnel), aesthetic reasons (preserving the above-ground view, landscape, and scenery), and also for weight capacity reasons (it may be more feasible to build a tunnel than a sufficiently strong bridge).

Some water crossings are a mixture of bridges and tunnels, such as the Denmark to Sweden link and the Chesapeake Bay Bridge-Tunnel in the eastern United States.

There are particular hazards with tunnels, especially from vehicle fires when combustion gases can asphyxiate users, as happened at the Gotthard Road Tunnel in Switzerland in 2001. One of the worst railway disasters ever, the Balvano train disaster, was caused by a train stalling in the Armi tunnel in Italy in 1944, killing 426 passengers.

17. HISTORY OF DAMS

The word "*dam*" can be traced back to Middle English, and before that, from Middle Dutch, as seen in the names of many old cities.

Most early dam building took place in Mesopotamia and the Middle East. Dams were used to control the water level. Mesopotamia's weather affected the Tigris and Euphrates rivers and could be quite unpredictable.

The earliest known dam is situated in Jawa, Jordan, 100 km northeast of the capital Amman. This gravity dam featured a 9 m high and

1 m wide stone wall, supported by a 50 m wide earth rampart (a high wide wall of stone with a path on top, built around a castle, town, etc.). The structure is dated to 3000 BC. The Ancient Egyptian Sadd Al-Kafara at Wadi Al-Garawi, located about 25 kilometers south of Cairo, was 102 m long at its base and 87 m wide. The structure was built around 2800 or 2600 B.C. as a dam for flood control, but was destroyed by heavy rain during construction or shortly afterwards.

Roman dam construction was characterized by "the Romans' ability to plan and organize engineering construction on a grand scale". Roman planners introduced a new concept of large reservoir dams which could secure a permanent water supply for urban settlements also over the dry season. Their pioneering use of water-proof hydraulic mortar and particularly Roman concrete allowed for much larger dam structures than previously built, such as the Lake Homs Dam, possibly the largest water barrier to date, and the Harbaqa Dam, both in Roman Syria. The highest Roman dam was the Subiaco Dam near Rome; its record height of 50 m remained unsurpassed until its accidental destruction in 1305.

Roman engineers made routine use of ancient standard designs like embankment dams and masonry gravity dams. Apart from that, they displayed a high degree of inventiveness, introducing most of the other basic dam designs which had been unknown until then. These include arch-gravity dams, arch dams, buttress dams, and multiple arch buttress dams, all of which were known and employed by the 2nd century A.D. (see List of Roman dams). Roman workforces also were the first to built dam bridges, such as the Bridge of Valerian in Iran.

Eflatun Pinar is a Hittite dam and spring temple near Konya, Turkey. It's thought to the time of the Hittite empire between the 15th and 13th century B.C.

The Kallanai is a massive dam of unhewn stone, over 300 meters long, 4.5 meters high and 20 meters (60 ft) wide, across the main stream of the Kaveri River in India. The basic structure dates to the 2nd century A.D. The purpose of the dam was to divert the waters of the Kaveri across the fertile delta region for irrigation via canals.

Du Jiang Yan is the oldest surviving irrigation system in China that included a dam that directed waterflow. It was finished in 251 B.C. A large earthen dam, made by the Prime Minister of Chu (state), Sunshu Ao, flooded a valley in modern-day northern Anhui province that created an enormous irrigation reservoir (62 miles in circumference), a reservoir that is still present today.

In Iran, bridge dams such as the Band-e Kaisar were used to provide hydropower through water wheels, which often powered water-raising mechanisms. One of the first was the Roman-built dam bridge in Dezful, which could raise 50 cubits of water for the water supply to all houses in the town. Also diversion dams were known. Milling dams were introduced which the Muslim engineers called the Pul-i-Bulaiti. The first was built at Shustar on the river Karun, Iran, and many of these were later built in other parts of the Islamic world. Water was conducted from the back of the dam through a large pipe to drive a water wheel and watermill. In the 10th century, Al-Muqaddasi described several dams in Persia. He reported that one in Ahwaz was more than 3,000 feet long, and that it had many water wheels raising the water into aqueducts through which it flowed into reservoirs of the city. Another one, the Band-i-Amir dam, provided irrigation for 300 villages.

In the Netherlands, a low-lying country, dams were often applied to block rivers in order to regulate the water level and to prevent the sea from entering the marsh lands. Such dams often marked the beginning of a town or city because it was easy to cross the river at such a place, and often gave rise to the respective place's names in Dutch. For instance the Dutch capital Amsterdam (old name Amstelredam) started with a dam through the river Amstel in the late 12th century, and Rotterdam started with a dam through the river Rotte, a minor tributary of the Nieuwe Maas. The central square of Amsterdam, covering the original place of the 800-year-old dam, still carries the name *Dam Square*, or simply *the Dam*.

18. HISTORY OF TUNNELS

The oldest used rail tunnel in the world was built in 1836. Only a short section of it remains now in Liverpool.

The World's oldest underwater tunnel is said to be the Terelek kaya tüneli under the Kizil River, a little south of the towns of Boyabat and Duragan in Turkey. It was built more than 2,000 years ago (possibly 5,000) and possibly had a defensive purpose.

The examples of other historical tunnels are as follows:

— The "qanat" or "kareez" of Persia is a water management system used to provide a reliable supply of water to human settlements or for irrigation in hot, arid, and semi-arid climates. The oldest and largest known system is in the Iranian city of Gonabad, which after 2,700 years, still provides drinking and agricultural water to nearly 40,000 people. Its depth is more than 360 m (1,180 ft), and its length is 45 km (28 mi).

— The Eupalinian aqueduct on the island of Samos (North Aegean, Greece). Built in 520 BC by the ancient Greek engineer Eupalinos of Megara. Eupalinos organized the work so that the tunnel construction began from both sides of mount Kastro. The two teams advanced simultaneously and met in the middle with excellent accuracy, something that was extremely difficult in that time. The aqueduct was of defensive importance, since it ran underground, and it was not easily found by an enemy who could otherwise cut off the water supply to Pythagoreion, the ancient capital of Samos. The tunnel's existence was recorded by Herodotus (as was the mole and harbour, and the third wonder of the island, the great temple to Hera, thought by many to be the largest in the Greek world). The precise location of the tunnel was only re-established in the 19th century by German archaeologists. The tunnel is 1,030 m long (3,380 ft) and visitors can still enter it.

— Sapperton Canal Tunnel on the Thames and Severn Canal in England was dug through hills, and was opened in 1789. It was 3.5 km (2.2 mi) long and allowed boat transport of coal and other goods. Above it runs the Sapperton Long Tunnel which carries the "Golden Valley" railway line between Swindon and Gloucester.

— The 1796 Stoddart Tunnel in Chapel-en-le-Frith in Derbyshire is reputed to be the oldest rail tunnel in the world. Rail wagons were horse-drawn at that time. The tunnel was created for the first true steam locomotive, from Penydarren to Abercynon. The Penydarren locomotive was built by Richard Trevithick. The locomotive made the historic journey from Penydarren to Abercynon in 1804. Part of this tunnel can still be seen at Pentrebach, Merthyr Tydfil, Wales. This is the oldest railway tunnel in the world, for self-propelled steam engines on rails.

— The Montgomery Bell Tunnel in Tennessee was a 290-foot (88 metre) long, high water diversion tunnel, 15×8 ft high (4.6×2.4 m), to power a water wheel. It was built by slave labour in 1819, being the first full-scale tunnel in North America.

— Crown Street Station, Liverpool, 1829. It was built by George Stephenson. It was a single track tunnel 291 yd long (266 m). It was bored from Edge Hill to Crown Street to serve the world's first passenger railway station. The station was abandoned in 1836 being too far from Liverpool city centre, with the area converted for freight use. Closed down in 1972, the tunnel is disused. However it is the oldest rail tunnel running under streets in the world.

— The 1.26 mile (2.03 km) 1829 Wapping Tunnel in Liverpool, England, was the first rail tunnel bored under a metropolis. Currently it has been disused since 1972. Having two tracks, the tunnel runs from Edge Hill in the east of the city to the south end. The tunnel is still in excellent condition and is being considered for reuse by Merseyrail rapid transit rail system, with maybe an underground station cut into the tunnel. The river portal is opposite the new Liverpool Arena being ideal for a serving station. If reused, it will be the oldest used underground rail tunnel in the world and oldest part of any underground metro system.

— Box Tunnel in England, opened in 1841, was the longest railway tunnel in the world at the time of construction. It was dug and has a length of 2.9 km (1.8 mi).

— The 0.75 mile long, constructed in 1842 Shildon tunnel near Darlington, England, is the oldest sizable tunnel in the world still in use under a settlement.

— The Thames Tunnel, built by Marc Isambard Brunel and his son Isambard Kingdom Brunel and opened in 1843, was the first underwater tunnel. Originally used as a foot-tunnel, it was a part of the East London Line of the London Underground until 2007, being the oldest section of the system. From 2010 the tunnel becomes a part of the London Overground system.

— The oldest underground sections of the London Underground were built using the cut-and-cover method in the 1860s. The Metropolitan, Hammersmith & City, Circle and District lines were the first to prove the success of a metro or subway system. Dating from 1863, Baker Street station is the oldest underground station in the world.
— The 1882 Col de Tende Road Tunnel, at 3,182 metres long, was one of the first long road tunnels under a pass, running between France and Italy.
— The rail Severn Tunnel was opened in late 1886, at 4 miles 624 yd (7,008 m) long, although only 2 $^1/_4$ miles (3.62 km) of the tunnel is actually under the river. The tunnel replaced the Mersey Railway tunnel's longest underwater record, which it held for less than a year.
— St Clair Tunnel, also opened later in 1890, linked the elements of the Greathead tunnels on a larger scale.
— The 1927 Holland Tunnel was the first underwater tunnel designed for automobiles. This fact required a novel ventilation system.

The list of tunnels by length:

— The Delaware Aqueduct in New York in the USA is the longest tunnel, of any type, in the world at 137 km (85 mi). It is drilled through solid rock.
— The Seikan Tunnel in Japan is the longest rail tunnel in the world at 53.9 km (33.5 mi), of which 23.3 km (14.5 mi) is under the sea.
— The Channel Tunnel between France and the United Kingdom under the English Channel is the second-longest, with a total length of 50 km (31 mi), of which 39 km (24 mi) is under the sea.
— The Lötschberg Base Tunnel opened in June 2007 in Switzerland is the longest land rail tunnel, with a total of 34.5 km (21.4 mi).
— The Lærdal Tunnel in Norway from Lærdal to Aurland is the world's longest road tunnel, intended for cars and similar vehicles, at 24.5 km (15.2 mi).

—The Zhongnanshan Tunnel in the People's Republic of China opened in January 2007 is the world's second longest highway tunnel and the longest road tunnel in Asia, at 18 km (11 mi).
—The longest canal tunnel is the Standedge Tunnel in the United Kingdom, over 5 km (3.1 mi) long.

19. A ROBOTIC SPACECRAFT

A robotic spacecraft is a spacecraft with no humans on board, that is usually under telerobotic control. A robotic spacecraft designed to make scientific research measurements is often called a space probe. Many space missions are more suited to telerobotic rather than crewed operation, due to lower cost and lower risk factors. In addition, some planetary destinations such as Venus or the vicinity of Jupiter are too hostile for human survival, given current technology. Outer planets such as Saturn, Uranus, and Neptune are too distant to reach with current crewed spaceflight technology, so telerobotic probes are the only way to explore them.

History

The first space mission, Sputnik 1, was an artificial satellite put into Earth orbit by the USSR on 4 October 1957. On 3 November 1957, the USSR orbited Sputnik 2, the first to carry a living animal into space—a dog.

The USA achieved its first successful space probe launch with the orbit of Explorer 1 on 31 January 1958. Explorer 1 weighed less than 14 kg compared to 83.6 kg and 508.3 kg for Sputniks 1 and 2 respectively. Nonetheless, Explorer 1 detected a narrow band of radiation surrounding the Earth, named the Van Allen belts after the scientist whose equipment detected it.

Only six other countries have successfully launched orbital missions using their own vehicles: France (1965), Japan (1970), China (1970), the United Kingdom (1971), India (1981), Israel (1988).

Most American space probe missions have been coordinated by the Jet Propulsion Laboratory, and European missions by the European Space Operations Centre, part of the European Space Agency (ESA). ESA has launched many spacecraft to carry out astronomy, and is a collaborator with NASA on the Hubble Space Telescope. There have been many successful Russian space missions. There have also been a few Japanese, Chinese, and Indian missions.

Design

In spacecraft design, the United States Air Force considers a vehicle to consist of the mission payload and the bus (or platform). The bus provides physical structure, thermal control, electrical power, attitude control and telemetry, tracking and commanding. The "flight system" of a spacecraft is divided into subsystems. These include:

- physical backbone structure (provides overall mechanical integrity of the spacecraft; ensures spacecraft components are supported and can withstand launch loads);
- command and data subsystem (responsible for command sequence storage, maintaining the spacecraft clock, collecting and reporting spacecraft telemetry data (e.g. spacecraft health), collecting and reporting mission data (e.g. photographic images);
- attitude control subsystem (responsible for the spacecraft's orientation in space and the positioning of movable parts);
- telecommunication subsystem (includes radio antennas, transmitters, and receivers which are used to communicate with ground stations on Earth, or with other spacecraft);
- electrical power subsystem (includes solar cells and a radioisotope thermoelectric generator, batteries for storing power and distribution circuitry that connects components to the power sources);
- temperature control and protection from the environment subsystem (includes mirrors and sunshades for additional protection from solar heating).

20. EFFICIENCY OF BRIDGE CONSTRUCTION

A bridge's structural efficiency may be considered to be the ratio of load carried to bridge mass, given a specific set of material types. In one common challenge students are divided into groups and given a quantity of wood sticks, a distance to span, and glue, and then asked to construct a bridge that will be tested to destruction by the progressive addition of load at the centre of the span. The bridge taking the greatest load is by this test the most structurally efficient. A more refined measure for this exercise is to weigh the completed bridge rather than measure against a fixed quantity of materials provided and determine the multiple of this weight that the bridge can carry, a test that emphasizes economy of materials and efficient glue joints.

A bridge's economic efficiency will be site and traffic dependent, the ratio of savings by having a bridge (instead of, for example, a ferry, or a longer road route) compared to its cost. The lifetime cost is composed of materials, labour, machinery, engineering, cost of money, insurance, maintenance, refurbishment, and ultimately, demolition and associated disposal, recycling, and replacement, less the value of scrap and reuse of components. Bridges employing only compression are relatively inefficient structurally, but may be highly cost-efficient where suitable materials are available near the site and the cost of labor is low. For medium spans, trusses or box beams are usually most economical, while in some cases, the appearance of the bridge may be more important than its cost efficiency. The longest spans usually require suspension bridges.

21. HISTORY OF BRIDGES

The first bridges appeared in ancient times. They were made by nature itself—as simple as a log fallen across a river or stones in the water. The first bridges made by humans were probably spans of cut wooden logs or planks and eventually stones, using a simple support and cross-girder arrangement. Some early Americans used trees or bamboo poles to get from one place to another across the water. Long reeds or other harvested fibres were woven together to form a connective rope which was used in early bridges.

The Arkadiko Bridge is one of four Mycenaean arch bridges and part of a former network of roads in the Peloponnese, in Greece. Dating to the Greek Bronze Age (13th century B.C.), it is one of the oldest arch bridges still in existence and use. Several intact (not damaged) arched stone bridges from the Hellenistic era can be found in the Peloponnese in southern Greece.

The greatest bridge builders of antiquity were the ancient Romans. The Romans built arch bridges and aqueducts that could stand in conditions that would damage or destroy earlier designs. Some stand today. An example is the Alcántara Bridge, built over the river Tagus, in Spain. The Romans also used cement, which reduced the variation of strength found in natural stone. One type of cement, called pozzolana, consisted of water, lime, sand, and volcanic rock. Brick and mortar (a mixture of cement, sand, and water) bridges were built after the Roman era, as the technology for cement was lost then later rediscovered.

The Arthashastra of Kautilya mentions the construction of dams and bridges. A Mauryan bridge near Girnar was surveyed by James Princep. The bridge was swept away during a flood, and later repaired by Puspagupta, the chief architect of emperor Chandragupta I. The bridge also fell under the care of the Yavana Tushaspa, and the Satrap Rudra Daman. The use of stronger bridges using plaited bamboo and iron chain was visible in India by about the 4th century. A number of bridges, both for military and commercial purposes, were constructed by the Mughal administration in India.

Although large Chinese bridges of wooden construction existed at the time of the Warring States, the oldest surviving stone bridge in China is the Zhaozhou Bridge, built from 595 to 605 A.D. during the Sui Dynasty. This bridge is also historically significant as it is the world's oldest open-spandrel stone segmental arch bridge. European segmental arch bridges date back to at least the Alconétar Bridge (approximately 2nd century A.D.), while the enormous Roman era Trajan's Bridge (105 A.D.) featured open-spandrel segmental arches in wooden construction.

Rope bridges, a simple type of suspension bridge, were used by the Inca civilization in the Andes mountains of South America, just prior to European colonization in the 1500s.

During the 18th century there were many innovations in the design of timber bridges by Hans Ulrich, Johannes Grubenmann, and others. The first book on bridge engineering was written by Hubert Gautier in 1716. A major breakthrough in bridge technology came with the erection of the Iron Bridge in Coalbrookdale, England in 1779. It used cast iron for the first time as arches to cross the river Severn.

With the Industrial Revolution in the 19th century, truss systems of wrought iron were developed for larger bridges, but iron did not have the tensile strength to support large loads. With the advent of steel, which has a high tensile strength, much larger bridges were built, many using the ideas of Gustave Eiffel.

In 1927, welding pioneer Stefan Bryła designed the first welded road bridge in the world which was later built across the river Słudwia Maurzyce near Łowicz, Poland in 1929. In 1995, the American Welding Society presented the Historic Welded Structure Award for the bridge to Poland.

22. THE MILLENNIUM BRIDGE (KAZAN)

The Millennium Bridge is a cable-stayed bridge that spans Kazanka River, in Kazan, Tatarstan, Russia. Its name originates from Kazan's thousand anniversary widely celebrated in 2005. The construction of the bridge began in 2004, the first part was ready in 2005 and the second part in 2007. The building cost was approximately 94 million euros. The bridge is 831 m long. The main part of this bridge is the 45 m pylon which looks like the letter "M". This form originates from Meñyıllıq (Cyrillic: Меңъеллык), the Tatar for thousand years old, or its Latin variant Millennium. The roadway carries three lanes of traffic and a pedestrian walkway in each direction. The bridge connects Gorky park and Fatikh Amirkhan Avenue.

23. THE USAGE OF BRIDGES

A bridge is designed for trains, pedestrian or road traffic, a pipeline or waterway for water transport or barge traffic. An aqueduct is a bridge that carries water, resembling a viaduct, which is a bridge that connects points of equal height. A road-rail bridge carries both road and rail traffic.

Bridges are subject to unplanned uses as well. The areas underneath some bridges have become makeshift shelters and homes to homeless people, and the undersides of bridges all around the world are spots of prevalent graffiti. Some bridges attract people attempting suicide, and become known as suicide bridges.

To create a beautiful image, some bridges are built much taller than necessary. This type, often found in east-Asian-style gardens, is called a "Moon bridge", evoking a rising full moon. Other garden bridges may cross only a dry bed of stream-washed pebbles, intended only to convey an impression of a stream. Often in palaces a bridge will be built over an artificial waterway as symbolic of a passage to an important place or state of mind. A set of five bridges cross a sinuous waterway in an important courtyard of the Forbidden City in Beijing, the People's Republic of China. The central bridge was reserved exclusively for the use of the Emperor, Empress, and their attendants.

Some bridges carry special installations such as the tower of Nový Most bridge in Bratislava which carries a restaurant. Other suspension bridge towers carry transmission antennas. A bridge can carry overhead power lines as does the Storstrøm Bridge. In railway network, an over-bridge is a bridge crossing over the course of the railway. In contrast, an under-bridge allows passage under the line.

24. THE EXAMPLES OF ANCIENT ARCHITECTURAL STRUCTURES

(The list of ancient architectural records)

The list of ancient architectural records consists of record-making architectural achievements of the Greco-Roman world from 800 BC to 600 AD.

1. Bridges

— The highest bridge over the water or ground was the single-arched Pont d'Alp which carried irrigation water for Aosta across a deep Alpine gorge. The height of its deck over the torrent below measures 66 m.

— The largest pointed arch bridge by span was the Karamagara Bridge in Cappadocia with a clear span of 17 m. Constructed in the 5th or 6th century AD across a tributary of the Euphrates, the now submerged structure is one if the earliest known examples of pointed architecture in late antiquity, and may even be the oldest surviving pointed arch bridge.
— The largest rivers to be spanned by solid bridges were the Danube and the Rhine, the two largest European rivers west of the Eurasian Steppe. The lower Danube was crossed at least at two different crossing points (Drobeta-Turnu Severin, Corabia), while the middle and lower Rhine at four (Mainz, Neuwied, Koblenz, Cologne). For rivers with strong currents and to allow swift army movements, pontoon bridges were also routinely employed. Going from the distinct lack of records of solid bridges spanning larger rivers elsewhere, the Roman feat appears to be unsurpassed anywhere in the world until well into the 19th century.
— The longest bridge, and one of the longest of all time, was Constantine's Bridge with an overall length of 2,437 m, 1,137 m of which crossed the Danube's riverbed.
— The second longest bridge was the monumental Trajan's Bridge which was situated further upstream from Constantine's. It was a record-holder in various categories, such as the largest bridge by span and the longest segmental arch bridge. Erected 104—105 AD by the engineer Apollodorus of Damascus for facilitating the advance of Roman troops in the Dacian Wars, it featured twenty-one spans covering a total distance of between 1,070 and 1,100 m. These twenty-one wooden arches spanned 50 m each from centreline to centreline. Its wooden superstructure was supported by twenty concrete piers.
— The longest existing Roman bridge is the sixty-two span Puente Romano at Mèrida, Spain (today 790 m).
— The total length of all aqueduct arch bridges of the Aqua Marcia to Rome, constructed from 144 to 140 BC, amounts to 10 km.
— Pont Serme in southern France reached a length of 1,500 m, but may be better classified as an arcaded viaduct.

— The Bridge at Limyra in modern-day Turkey, consisting of twenty-six flat brick arches, features the greatest lengths of all extant masonry structures in this category (360 m).
— The tallest bridge was the Pont du Gard, which carried water across the Gard river to Nomes, southern France. The 270 m long aqueduct bridge was constructed in three tiers which measure successively 20.5 m, 19.5 m and 7.4 m, adding up to a total height of 47.4 m above the water-level. When crossing deeper valleys, Roman hydraulic engineers, for reasons of relative economics, preferred inverted siphons over bridges; this is evident in the Lyon aqueduct where seven out of nine siphons exceed the 45 m mark, reaching depths up to 123 m. The tallest road bridges were the monumental Alcántara Bridge, Spain (ca. 42 m), and the bridge at Narni (30 m).
— The widest bridge was the Pergamon Bridge in Pergamon, Turkey. The structure served as a substruction for a large court in front of the Serapis Temple, allowing the waters of the Selinus river to pass unrestricted underneath. Measuring 193 m in width, the dimensions of the extant bridge are such that it is frequently mistaken for a tunnel, although the whole structure was actually erected above ground. A similar design was also executed in the Nysa Bridge which straddled the local stream on a length of 100 m, supporting a forecourt of the city theatre. By comparison, the width of a normal, free standing Roman bridge did not exceed 10 m.
— The bridge with the greatest load capacity—as far as can be determined from the limited research — was the Alcántara Bridge the largest arch of which can support a load of 52 t, followed by the Ponte de Pedra (30 t), Puente Bibei (24 t) and Puente de Ponte do Lima (24 t) (all in Hispania). According to modern calculations, the Limyra Bridge, Asia Minor, can support a 30 t vehicle on one arch plus a load of 500 kp/mI on the remaining surface of the arch. The load limit of Roman arch bridges was thus far in excess of the live loads imposed by ancient traffic.
— The bridge with the flattest arches was the Trajan's Bridge, with a span-to-rise ratio of about 7 to 1. It also held several other important architectural records. A number of fully-

stone segmental arch bridges, scattered throughout the empire, featured ratios of between 6.4 and 3.0, such as the relatively unknown Bridge at Limyra, the Ponte San Lorenzo and the Alcontar Bridge. By comparison, the Florentine Ponte Vecchio, one of the earliest segmental arch bridges in the Middle Ages, features a ratio of 5.3 to 1.

— The bridge with the most slender arch was the Pont-Saint-Martin in the Alpine Aosta Valley. A favourable ratio of arch rib thickness to span is regarded as the single most important parameter in the design of stone arches. The arch rib of the Pont-Saint-Martin is only 1.03 m thick what translates to a ratio of 1/34 respectively 1/30 depending on whether one assumes 35.64 m or 31.4 m to be the value for its clear span. A statistical analysis of extant Roman bridges shows that ancient bridge builders preferred a ratio for rib thickness to span of 1/10 for smaller bridges, while they reduced this to as low as 1/20 for larger spans in order to relieve the arch from its own weight.
— The bridge with the most slender piers was the three-span Ponte San Lorenzo in Padua, Italy. A favourable ratio between pier thickness and span is considered a particularly important parameter in bridge building, since wide openings reduce stream velocities which tend to undermine the foundations and cause collapse. The approximately 1.70 m thick piers of the Ponte San Lorenzo are as slender as one-eighth of the span. In some Roman bridges, the ratio still reached one-fifth, but a common pier thickness was around one third of the span. Having been completed sometime between 47 and 30 BC, the San Lorenzo Bridge also represents one of the earliest segmental arch bridges in the world with a span to rise ratio of 3.7 to 1.

2. Columns

List of Roman victory columns

— The tallest Corinthian columns, a style which was particularly popular in Roman monumental construction, adorned the Temple of Jupiter at Baalbek, reaching a height of 19.82 m including base and capital; their shafts measure 16.64 m high.

The next two tallest are those of the Temple of Mars Ultor in Rome and of the Athenian Olympieion which are 17.74 m (14.76 m) and 16.83 m (14.00 m) high, respectively. These are followed by a group of three virtually identical high Corinthian orders in Rome: the Hadrianeum, the Temple of Apollo Sosianus and the Temple of Castor and Pollux, all of which are in the order of 14.80 m (12.40 m) height. All these colonnades, though, are eclipsed by the single Pompey's Pillar which is 26.85 m high with its base and capital (20.46 m without).

— The tallest victory column was the Column of Marcus Aurelius, Rome, with the height of its top above ground being 39.72 m. It thus exceeds its model, Trajan's Column, by 4.65 m, chiefly due to its higher pedestal. In antiquity, the imperial capitals of Rome and Constantinople saw the erection of many more triumphal columns, some of which, like the demolished Column of Justinian, may well have exceeded these heights.

3. Dams

— The dam at Cornalvo, Spain, is one of the tallest Roman dams still in use (28 m).

— The largest arch dam was the Glanum Dam in the French Provence. Since its remains were almost completely obliterated by a 19th-century dam on the same spot, its reconstruction relies on prior documentation, according to which the Roman dam was 12 m high, 3.9 m wide and 18 m long at the crest. Being the earliest known arch dam, it remained unique in antiquity and beyond (aside from the Dara Dam whose dimensions are unknown).

— The largest arch-gravity dam was the Kasserine Dam in Tunisia, arguably the biggest Roman dam in North Africa with 150 m length by 10 m height by 7.3 m width. However, despite its curved nature, it is uncertain whether the 2nd century AD dam structurally acted by arching action and not solely by its sheer weight; in this case it would be classified as a gravity dam and considerably smaller structures in Turkey or the Spanish Puy Foradado Dam would move up in this category.

— The largest bridge dam was the Band-e Kaisar which was erected by a Roman workforce on Sassanid territory in the 3rd century AD. The approximately 500 m long structure, a novel combination of overflow dam and arcaded bridge, crossed Iran's most effluent river on more than forty arches. The most eastern Roman civil engineering structure ever built, its dual-purpose design exerted a profound influence on Iranian dam building.

— The largest multiple arch buttress dam was the Esparragalejo Dam in Spain, whose 320 m long wall was supported on its air face by buttresses and concave-shaped arches. Dated to the 1st century AD, the structure represents the first and, as it appears, only known dam of its type in ancient times, although portions of the Portuguese Muro Dam were similarly shaped.

— The longest buttress dam was the 632 m long Consuegra Dam (3rd—4th century AD) in central Spain which is still fairly well preserved. Instead of an earth embankment, its only 1.3 m thick retaining wall was supported on the downstream side by buttresses in regular intervals of 5 to 10 m. In Spain, a large number of ancient buttress dams are concentrated, representing nearly one third of the total found there.

— The longest gravity dam, and longest dam overall, impounds the Lake of Homs in Syria. Built in 284 AD by emperor Diocletian for irrigation, the 2,000 m long and 7 m high masonry dam consists of a concrete core protected by basalt ashlar. The lake, 6 miles long by 2.5 miles wide, is the biggest Roman reservoir in the Near East and possibly the largest artificial lake constructed up to that time. Enlarged in the 1930s, it is still a landmark of Homs which it continues to supply with water. Further notable dams in this category include the little-studied 900 m long Wadi Caam II dam at Leptis Magna and the Spanish dams at Alcantarilla and at Consuegra.

— The tallest dam belonged to the Subiaco Dams at the central Italian town of the same name. Constructed by Nero (54—68 AD) as an adjunct to his villa on the Aniene river, the three reservoirs were highly unusual in their time for serving recreational rather than utilitarian purposes. The biggest dam of the group is estimated to have reached a height of 50 m. It remained unsurpassed in the world until its accidental destruction in 1305 by two monks who fatally removed cover stones from the top. Also quite tall structures were Almonacid de la Cuba Dam (34 m), Cornalvo Dam (28 m), and Proserpina Dam (21.6 m), all of which are located in Spain and still of substantially Roman fabric.

4. Domes

The largest dome in the world for more than 1,700 years was the Pantheon in Rome. Its concrete dome spans an interior space of 43.45 m, which corresponds exactly to its height from floor to top. Its apex concludes with a 8.95 m wide oculus. The structure remained unsurpassed until 1881 and stills holds the title of the largest unreinforced solid concrete dome in the world. The Pantheon has exercised an immense influence on Western dome construction to this day.

The largest dome out of clay hollowware ever constructed is the Caldarium of the Baths of Caracalla in Rome. The now ruined dome, completed in 216 AD, had an inner diameter of 35.08 m. For reduction of weight its shell was constructed of amphora joined together, a quite new method then which could do without time-consuming wooden centring.

The largest half-domes were found in the Baths of Trajan in Rome, completed in 109 AD.

The largest stone dome was the Western Thermae in Gerasa, Jordan, constructed around 150/175 AD. The 15 m wide dome of the bath complex was also one of the earliest of its kind with a square ground plan.

5. Fortifications (Roman military engineering)

The longest city walls were those of Classical Athens. Their extraordinary length was due to the construction of the famous Long Walls which played a key role in the city's maritime strategy, by providing it with a secure access to the sea and offering the population of Attica a retreat zone in case of foreign invasions. At the eve of the Peloponnesian War (431—404 BC), Thucydides gave the length of the entire circuit as follows: 43 stades (7.6 km) for the city walls without the southwestern section covered by others walls and 60 stades (10.6 km) for the circumference of the Peiraeus port. A corridor between these two was established by the northern Long Wall (40 stades or 7.1 km) and the Phaleric Wall (35 stades or 6.2 km). Assuming a value of 177.6 m for one Attic stade, the overall length of the walls of Athens thus measured about 31.6 km. The structure, consisting of sun-dried bricks built on a foundation of limestone blocks, was dismantled after Athens' defeat in 404 BC, but rebuilt a decade later. Syracuse, Rome (Aurelian Walls) and Constantinople (Walls of Constantinople) were also protected by very long circuit walls.

6. Monoliths

The largest monolith lifted by a single crane can be determined from the number of holes (each of which points at the use of one crane) in the lifted stone block. By dividing its weight by their number, one arrives at a maximum lifting capacity of 7.5 to 8 t as exemplified by a cornice block at the Trajan's Forum and the architrave blocks of the Temple of Jupiter at Baalbek. Based on a detailed Roman relief of a construction crane, the engineer O'Connor calculates a slightly less lifting capability, 6.2 t, for such type of a crane, on the assumption that it was powered by five men and using a three-pulley block.

The largest monolith lifted by cranes was the 108 t heavy corner cornice block of the Jupiter temple at Baalbek, followed by an architrave block weighing 63 t, both of which were raised to a height of about 19 m. The capital block of Trajan's Column, with a weight of 53.3 t, was even lifted to 34 m above the ground. As such enormous loads far exceeded the lifting capability of any single treadwheel crane, it is assumed that Roman engineers set up a four-masted lifting tower in the midst of which the stone blocks were vertically raised by the means of capstans placed on the ground around it.

The largest monoliths were two giant building blocks in the quarry of Baalbek: an unnamed rectangular block which was only recently discovered is measured at 20 m × 4.45 m × 4.5 m, yielding a weight of 1,242 t. The similarly shaped Stone of the Pregnant Woman nearby weights 1,000.12 t. Both blocks were intended for the Roman temple nearby, but were left for unknown reasons at their sites.

The largest monolith was a group of three monumental blocks in the podium of the Jupiter temple at Baalbek. The individual stones are 19.60 m, 19.30 m, and 19.10 m long respectively, with a depth of

3.65 m and a height of 4.34 m. Weighing approximately 800 t on average, they were transported to a distance of 800 m and probably pulled by the means of ropes and capstans into their final position. The supporting stone layer beneath features a number of blocks which are still in the order of 350 t. The various giant stones of Roman Baalbek rank high among the largest man-made monoliths in history.

The largest monolithic columns were used by Roman builders who preferred them over the stacked drums typical of classical Greek architecture. The logistics and technology involved in the transport and erection of extra-large single-piece columns were demanding: as a rule of thumb, in the length range between 40 and 60 Roman feet (approximately 11.8 to 17.8 m), the weight of the column shafts, due to their larger diameter, doubled with every ten feet from 50 over 100 to 200 t. Despite this, 40 and also 50 feet tall monolithic shafts can be found in a number of Roman buildings, but examples reaching 60 feet are only in evidence in two unfinished granite columns which still lie in the Roman quarry of Mons Claudianus, Egypt. One of the pair, which was discovered only in the 1930s, has an estimated weight of 207 t. All these dimensions, however, are surpassed by Pompey's Pillar, a free-standing victory column erected in Alexandria in 297 AD: measuring 20.46 m high with a diameter of 2.71 m at its base, the weight of its granite shaft has been put at 285 t.

The largest monolithic dome crowned the early 6th century AD Mausoleum of Theodoric in Ravenna, then capital of the Ostrogothic kingdom. The weight of the single, 10.76 m wide roof slab has been calculated at 230 t.

7. Roads

The longest trackway was the Diolkos near Corinth, Greece, measuring between 6 and 8.5 km. The paved roadway allowed boats to be pulled across the Isthmus of Corinth, thus avoiding the long and dangerous sea trip around the Peloponnese peninsula. Working by the railway principle, with a gauge of around 160 cm between two parallel grooves cut into the limestone paving, it remained in regular and frequent service for at least 650 years. By comparison, the world's first overland wagonway, the Wollaton Wagonway of 1604, ran for 3 km.

8. Roofs

The largest prop-and-lintel roof by span spanned the Parthenon in Athens. It measured 19.20 m between the cella walls, with an unsupported span of 11.05 m between the interior colonnades. Sicilian temples of the time featured slightly larger cross sections, but these may have been covered by truss roofs instead.

The largest truss roof by span covered the Aula Regia (throne room) built for emperor Domitian (81—96 AD) on the Palatine Hill, Rome. The timber truss roof had a width of 31.67 m, slightly surpassing the postulated limit of 30 m for Roman roof constructions. Tie-beam trusses allowed for much larger spans than the older prop-and-lintel system and even concrete vaulting: nine out of the ten largest rectangular spaces in Roman architecture were bridged this way, the only exception being the groin vaulted Basilica of Maxentius.

9. Tunnels

The deepest tunnel was the Claudius Tunnel, constructed in eleven years time by emperor Claudius (41—54 AD). Draining the Fucine Lake, the largest Italian inland water, 100 km east of Rome, it is widely deemed as the most ambitious Roman tunnel project as it stretched ancient technology to its limits. The 5,653 m long tunnel, passing under Monte Salviano, features vertical shafts up to 122 m depth; even longer ones were run obliquely through the rock. After repairs under Trajan and Hadrian, the Claudius tunnel remained in use until the end of antiquity. Various attempts at restoration succeeded only in the late 19th century.

The longest road tunnel was the Cocceius Tunnel near Naples, Italy, which connected Cumae with the base of the Roman fleet, Portus Julius. The 1000 m long tunnel was part of an extensive underground network which facilitated troop movements between the various Roman facilities in the volcanic area. Built by the architect Cocceius Auctus, it featured paved access roads and well-built mouthes. Other road tunnels include the Crypta Neapolitana to Pozzuoli (750 m long, 3—4 m wide and 3—5 m high), and the similarly sized Grotta di Seiano.

The longest tunnel as well was the 94 km long Gadara Aqueduct in northern Jordan. This recently discovered structure provided for hundreds of years water for Adraa, Abila, and Gadara, three cities of the ancient Decapolis. Only 35 km long as the crow flies, its length was almost tripled by following closely the contours of the local topography, avoiding valleys and mountain ridges alike. The monumental work seemed to be carried out in seven stages of construction between 130 and 193 AD. The distance between the individual vertical shafts was on average 50 m. Probably the project was initiated by Hadrian, who had granted privileges to the cities during a longer stay in the Decapolis. The aqueduct remained operational until the Byzantines lost control of the region after the Battle of Yarmuk in 636.

The longest tunnel excavated from opposite ends was built around the end of the 6th century BC for draining and regulating Lake Nemi, Italy. Measuring 1,600 m, it was almost 600 m longer than the slightly older Tunnel of Eupalinos on the isle of Samos, the first tunnel in history to be excavated from two ends with a methodical approach. The Albano Tunnel, also in central Italy, reaches a length of 1,400 m. It was excavated no later than 397 BC and is still in service. Determining the tunnelling direction underground and coordinating the advance of the separate work parties made meticulous surveying and execution on the part of the ancient engineers necessary.

10. Vaulting

The largest barrel vault by span covered the Temple of Venus and Roma, Rome. Built between 307 and 312 AD, the vaulted structure replaced the original wooden truss roof from Hadrian's time.

The largest groin vault by span roofed the 25.01 m wide main nave of the Basilica of Maxentius on the Forum Romanum, built in the early 4th century.

Additional video
(Видеосюжеты для дополнительного просмотра)

Видеосюжеты для дополнительного просмотра можно найти по ссылке: http://englishtech.ru/video/dopolnitelnoe_video/.

Просмотр дополнительных видеосюжетов по той или иной теме курса носит вариативный характер. Видеосюжеты, а также форма работы с ними, отбираются преподавателем или студентом самостоятельно.

Тематика дополнительных видеосюжетов:

1	Is Becoming an Engineer Worth All the Hard Work?	Module 1
2	What Is Engineering Technology?	Module 1
3	Electrical Engineering	Module 2
4	What Is Mechanical Engineering?	Module 2
5	Alkali metals	Module 4
6	Chemical Properties of Metals	Module 4
7	Materials Science and Engineering at Penn State	Module 4
8	Materials Science Centre Business Benefits	Module 4
9	Materials Science Centre. What Does It Do?	Module 4
10	Precision Cooking of Glass	Module 4
11	Understanding Plastic Materials—Definition of Plastics	Module 4
12	Understanding Plastic Materials	Module 4
13	NEC Optical Networking Solution 40G ROADM	Module 11
14	Tap Optical Fibre	Module 11
15	Building Panama Canal	Module 12
16	How Was the Channel Tunnel Made	Module 12

17	The Effects of the Channel Tunnel	Module 12
18	Tunnel Boring Machine Animation	Module 12
19	At Home with Trevor Baylis	Module 13
20	Eureka Episode 9—Kinetic Energy	Module 13
21	Physics. Kinetic Energy	Module 13
22	Saving Energy with Solar Power. Measuring Amps to Save Energy	Module 13
23	Solar Energy Basics for Your Home	Module 13
24	Trevor Baylis—Inventor of the Wind-up Radio Part 1—Smarta video interview	Module 13
25	Trevor Baylis Warns to Take Invention Seriously	Module 13
26	Linn State—Automation Robotics Technology	Module 14
27	New Version of Robot ASIMO	Module 14
28	Robot Violonist	Module 14
29	Robot Fish	Module 14
30	Robotic Technology HQ	Module 14
31	A Magic Ball Gadget	Module 15
32	Dane Elecs Digital Pen	Module 15
33	How Big or Small Is the Gadget?	Module 15
34	Latest Tech Gadgets	Module 15
35	Open Social Tutorial—Gadget Basics	Module 15
36	The Top 5 Party Gadgets	Module 15
37	Turn a Calculator into a Metal Detector	Module 15
38	Gadget of i-sobot	Module 15
39	35W Bridge Construction	Module 16
40	Bridge Construction—3D Animation	Module 16
41	Famous Bridges around the World	Module 16
42	Famous Bridges of the World	Module 16
43	Movable Bridge—Holland	Module 16
44	Movable Steel Bridges	Module 16
45	The Impossible Bridge	Module 16

Возможные формы работы с видеосюжетами:

— просмотр (с аудио/без аудио) и выявление основной идеи видеосюжета;

— просмотр (с аудио/без аудио) и передача сути видеосюжета на английском языке (устно или письменно);

— просмотр (с аудио/без аудио) и составление вопросов к видеосюжету (устно или письменно);

— прослушивание (без видео) сюжета и выявление основной идеи;

— прослушивание (без видео) сюжета и передача сути на английском языке (устно или письменно);

— прослушивание (без видео) сюжета и составление вопросов к видеосюжету (устно или письменно);

— прослушивание и лексический анализ (определение ключевых лексических единиц; подбор синонимов, антонимов; составление словосочетаний; формирование навыка их употребления в требуемом контексте);

— прослушивание и функциональный анализ текста (интерпретация информации согласно заданным параметрам, ранжирование информации, представление информации в графическом виде (схемы, таблицы);

— самостоятельное составление заданий к тексту преподавателем исходя из конкретных условий протекания учебного процесса.

Internet references
(Ссылки на образовательные интернет-сайты)

В целях самосовершенствования и самоорганизации самостоятельной работы по повышению уровня владения английским языком предлагаем следующие сайты сети Интернет:

Изучение грамматики английского языка:

PARTS OF SPEECH/ЧАСТИ РЕЧИ
http://www.1-language.com/eslquizzes/partsofspeech.htm

PRONOUNS/МЕСТОИМЕНИЯ
http://www.1-language.com/eslquizzes/personalpronouns.htm
http://www.englishpage.com/grammar/Pronouns/Exercises/
http://www.learnenglish.de/tests/pronounstest.htm
http://www.ucl.ac.uk/internet-grammar/nouns/ex3.htm

NOUNS/СУЩЕСТВИТЕЛЬНЫЕ
http://www.1-language.com/eslquizzes/collectivenouns.htm
http://www.learnenglish.de/Games/CountUncount/CountUncount.htm
http://www.ucl.ac.uk/internet-grammar/nouns/ex2.htm

VERBS/ГЛАГОЛЫ
http://www.ucl.ac.uk/internet-grammar/verbs/ex2.htm

SUBJECT—VERB AGREEMENT/СОГЛАСОВАНИЕ ПОДЛЕЖАЩЕГО И СКАЗУЕМОГО
http://www.1-language.com/eslquizzes/nounverbmatch1.htm
http://www.1-language.com/eslquizzes/subjectverb1.htm
http://www.englishpage.com/grammar/Subject_Verb_Agreement/Exercises/

ADVERBS/НАРЕЧИЯ
http://www.1-language.com/eslquizzes/adverbs.htm

http://www.englishpage.com/grammar/Adverbs/Exercises/

ADJECTIVES/ПРИЛАГАТЕЛЬНЫЕ

http://www.englishpage.com/grammar/Adjectives/Exercises/
http://www.learnenglish.de/tests/adjectives/adjectiveorder.htm

PREPOSITIONS/ПРЕДЛОГИ

http://www.englishpage.com/grammar/Prepositions/Exercises/
http://www.learnenglish.de/Games/Prepositions/PreposPlace.htm
http://www.learnenglish.de/Games/Prepositions/PreposTime.htm

SENTENCE STRUCTURE/СТРУКТУРА ПРЕДЛОЖЕНИЯ

http://www.1-language.com/eslquizzes/sentencestructure1.htm
http://www.1-language.com/eslquizzes/sentencestructure2.htm
http://www.ucl.ac.uk/internet-grammar/function/ex4.htm
http://www.ucl.ac.uk/internet-grammar/function/ex5.htm
http://www.ucl.ac.uk/internet-grammar/function/ex8.htm

TENSES/ВРЕМЕНА

http://www.learnenglish.de/Games/Tenses/TestItTenses.htm
http://www.englishpage.com/grammar/Verb_Tenses/Exercises/

AUXILIARY VERBS/ВСПОМОГАТЕЛЬНЫЕ ГЛАГОЛЫ

http://www.1-language.com/eslquizzes/relativepronouns.htm
http://www.1-language.com/eslquizzes/subjectverb2.htm
http://www.learn-english-online.org/Lesson1/Work/Introductions1.htm
http://www.learnenglish.de/Games/HaveHas/DoDoes.htm
http://www.ucl.ac.uk/internet-grammar/verbs/ex4.htm

MODALS/МОДАЛЬНЫЕ ГЛАГОЛЫ

http://www.englishpage.com/grammar/Modal_Verbs/Exercises/
http://www.quia.com/cm/69578.html

PASSIVE/ПАССИВНЫЙ ЗАЛОГ

http://www.quia.com/cm/139704.html
http://www.ucl.ac.uk/internet-grammar/verbs/ex7.htm

QUESTIONS/ВОПРОСИТЕЛЬНЫЕ ПРЕДЛОЖЕНИЯ

http://www.learnenglish.de/tests/mixquestion.htm
http://www.learnenglish.de/tests/tagqs.htm

CONDITIONALS/УСЛОВНЫЕ ПРЕДЛОЖЕНИЯ
http://www.learnenglish.de/Games/Conditionals/typeI.htm
http://www.learnenglish.de/Games/Conditionals/typeII.htm

Профессионально ориентированные тексты на английском языке для чтения:
http://www.wikipedia.org

Профессионально ориентированные аудио- и видеоматериалы на английском языке для прослушивания:
http://www.youtube.com

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