МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
МИКОЛАЇВСЬКИЙ НАЦІОНАЛЬНИЙ АГРАРНИЙ УНІВЕРСИТЕТ

Кафедра іноземних мов

Англійська мова:

методичні рекомендації та навчальний матеріал для самостійної роботи здобувачів ступеня вищої освіти «магістр» спеціальності 141 «Електроенергетика, електротехніка та електромеханіка» денної форми навчання

Миколаїв
2016

УДК 811.111
ББК 81.2 Англ
А64
Друкується за рішенням науково-методичної комісії факультету культури й виховання Миколаївського національного аграрного університету від 26.01.16 , протокол № 5.

Укладач:

О. В. Артюхова – канд. пед. наук, доцент кафедри іноземних мов Миколаївського національного аграрного університету.

Рецензенти:

Р. О. Гришкова – доктор педагогічних наук, професор кафедри іноземних мов факультету філології Миколаївського Чорноморського державного університету ім. Петра Могили;

К. В. Тішечкіна – кандидат філологічних наук, доцент кафедри іноземних мов Миколаївського національного аграрного університету.

ЗМІСТ

Передмова

Методичні рекомендації та навчальний матеріал з іноземної мови для аудиторної та самостійної роботи призначено для студентів 5 курсу ОКР «Магістр» інженерно-енергетичного факультету денної форми навчання за всіма напрямами підготовки.

Основною метою даних рекомендацій є формування необхідної комунікативної спроможності у сферах ситуативного професійного спілкування в усній та письмовій формах, забезпечення розвитку навичок аналітичного читання, розуміння та перекладу професійно-орієнтованих іншомовних джерел, написання рефератів, анотацій та інших документів іноземною мовою.

Основними завданнями методичних рекомендацій є формування у студентів умінь і навичок для практичного володіння діловою іноземною мовою під час усного та письмового професійного спілкування у конкретній галузі, користування усним монологічним та діалогічним мовленням у межах побутової, суспільно-політичної та фахової тематики, перекладу з іноземної мови на рідну текстів професійного спрямування.

Мотивацією для студентів піч час роботи з даними методичними рекомендаціями служить професійна потреба студента стати висококваліфікованим фахівцем з умінням спілкуватися іноземною мовою та здобути інформацію з новітньої іноземної літератури за фахом, аналізувати її та використовувати у своїй науково-дослідній роботі. Дисципліна « Іноземна мова за професійним спрямуванням» - важлива складова частина підготовки фахівців аграрного профілю в умовах постійного розширення міжнародних зв`язків України.

За кожну тему студент може отримати від 15-25 балів, що передбачено навчальною програмою з іноземних мов.

Методичні рекомендації розроблені згідно до вимог типової базової програми. Запропоновані вправи та завдання забезпечують швидке й ефективне засвоєння студентами лексичного матеріалу.

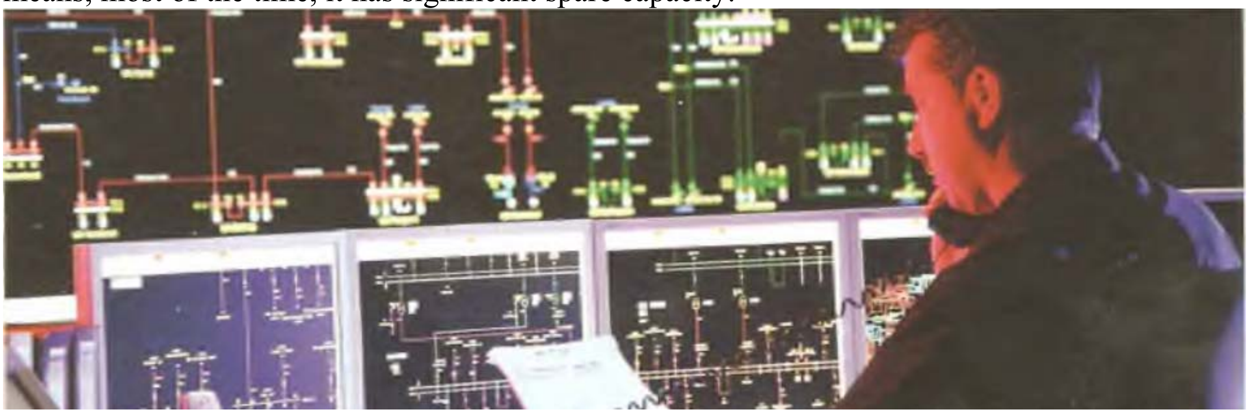
Для підготовки методичних рекомендацій використовувались матеріали з новітніх підручників, автентичних джерел та періодичних видань.

1 MEASURABLE PARAMETRES

A Supply, demand and capacity

The article below is from the technology section of a business magazine.

Calculating the capacity of an electricity grid - the amount of energy it needs to supply to users - might seem simple. Just add up the power supplied over a given period of time to give the total amount consumed by users. Then, divide the cumulative amount of power used during the whole period by the number of hours in the period. The result is an average level of consumption per hour. But there's one problem with this method - and it's a major one. The rate of power consumption - the amount that's begin consumed at a particular moment - is not constant. In other words, consumption does not stay at the same level all the time. So electricity supply requirements can not simply be averaged out over time . People use more power at certain times of day, and less at other times, which means that demand for power fluctuates significantly. Generally, it rises to a maximum in the evening (peak demand is at evening mealtimes), and falls to its lowest levels during the night. These fluctuations are so big that at peak times consumption can be twice as high as it is during off-peak times. Clearly, the grid needs to have sufficient capacity to meet demand when consumption peaks. But since each peak is brief, the grid will only run to capacity - at or close to its maximum capability - for a few moments each day .This means, most of the time, it has significant spare capacity.



B Input, output and efficiency

Power lines and transformers are relatively inefficient, wasting energy – mainly by giving off heat. As a result, there is a difference between input - the amount of energy put into the grid by power stations, and output – the amount used by consumers. On a typical grid, the difference between input and output is about 7 % - there is a 7 % energy loss. But if electricity is generated at the place where it's consumed , and not transmitted through long -distance power lines, this loss can be avoided . Consequently, locally produced electricity is more efficient than grid - supplied power, as there is a gain in efficiency of around 7%.

Photovoltaic solar panels

One way to produce power locally is with phtovoltaics (PVs) - often called solar panels. However, many PV installations are still connected to the electricity grid. This means that when there is surplus power - when electricity is being produced by the solar panels faster than it is needed in the home - it is fed in to the grid. If consumption exceeds production - if electricity is being used in the home faster than the solar panels can produce it - then power is taken from the grid. Homes with low consumptio may therefore be come net producers of power, producing more electricity than they consume.

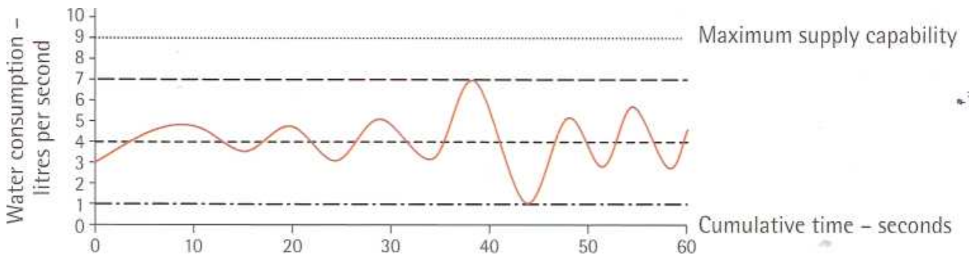
1.1 An engineer is talking to a colleague about the design of a fuel tank for a water pump. Complete the explanation using the words in the box. Look at A opposite to help you.

average	constant	consumption	duration
capacity	consume	cumulative	rate

fuel (0 .... -for this engine is about 1.8 litres per hour. Of course, sometimes it (2) .... a bitmore, sometimes a bit less, depending ....onthe workload. But 1.8 is an (3)……. figure. And let's say the *(4)*………… of a work shift is 8 hours. The pump will have to be stopped occasionally, to clean the intake filter, so it wonn't be 8 hours of (5) ………… running. But we'll say 8 hours, to be on the safe side. So 8 hours of running at a (6) ………… of 1.8 litres per hour gives 12. litres of *(7)* ………………. Consumption over a shift. So if we want the pump to have sufficient fuel autonomy for an 8-hour shift, the (8) ………….. of the fuel tank needs to be 12 litres, minimum.

1.2 The graph below shows water consumption in a washing process at a manufacturing plant. Write figures to complete the comments. Look at A opposite to help you.

1. Water consumption fluctuated between and litres per second.
2. Averaged out over the period shown, consumption was roughly litres per second.
3. Consumption peaked at a rate of litres per second.
4. If the process ran to capacity, it could use water at a rate of litres per second.
5. When consumption peaked, the process had spare capacity of litres per second.



1.3 Choose the correct words from the brackets to complete the explanations from a guided tour of a manufacturing plant. Look at A and B opposite to help you.

1. A lot of heat is generated in this part of the process. And all of that (input / output) is recycled - it provides a (demand / supply) of heat for the next stage of the process. So it's quite an (efficient / inefficient) system.
2. Sometimes, there's (insufficient / surplus) heat, and it can't all be recycled. At other times there isn't quite enough recycled heat to keep up with (peak / off-peak) demand for heat energy further along the process.
3. Some material is lost in the washing process, but the mass of water absorbed is greater than the mass of material lost. So there's a net (loss / gain) in total mass.

Over to you

Think of an energy-consuming appliance you're familiar with. Imagine you are starting a project to redesign it, in order to improve its efficiency. Answer the following questions:

- **How much energy does the appliance consume? Is consumption constant or fluctuating? Describe any fluctuations, in terms of average and peak consumption.**
- **How efficient is the appliance? What are the main reasons for inefficiencies? What are your first thoughts on how efficiency could be improved?**

2 MATERIAL TYPES

A

Metals and non-metals

Engineering materials can be divided into:

- metals - examples of metallic materials are iron (Fe) and copper (Cu)
- non-metals - examples of non-metallic materials are carbon (C) and silicon (Si).

As iron is such a widely used material, metals can be divided into:

- ferrous metals - those that contain iron
- non-ferrous metals - those that do not contain iron.

B

Elements, compounds and mixtures

With regard to the chemical composition of materials - the chemicals they contain, and how those chemicals are combined - three main categories can be used:

- Elements are pure materials in their most basic form. They cannot be broken down into different constituents ('ingredients'). Examples of elements widely used in engineering materials are iron, carbon and aluminium (Al).
- Compounds consist of two or more elements that are chemically bound - that is, combined by a chemical reaction. An everyday example is water, which is a compound of hydrogen (H) and oxygen (O).
- Mixtures consist of two or more elements or compounds which are mixed together, but which are not chemically bound. In engineering, common examples are alloys - that is, metals which have other metals and/or non-metals mixed with them. A common example is steel, which is an iron-carbon alloy, and can include other alloying metals - metals which are added to alloys, in small quantities relative to the main metal. Examples of widely used alloying metals are chromium (Cr), manganese (Mn) and tungsten (W).

BrE: aluminium /.æl.ju'min.i.am/; *AmE: aluminum* /a'hn.mi.nnm/

C

Composite materials
The article below is from an engineering journal.

Materials under the microscope: composites

When you think of examples of hi-tech materials, composite materials come to mind - such as carbon-fibre, used in aerospace and Formula 1 cars. But although we think of composites as hi-tech and highly expensive, that's not always true. The earliest examples of composite materials were bricks made from mud and straw. Or, to use the correct composite terms, from straw reinforcement - the structural network that reinforces the material inside, and a mud matrix-the material surrounding the reinforcement. These terms explain what a composite material is: a matrix with a reinforcing material inside it. A modern, everyday example is fibreglass - correctly called glass- reinforced plastic (GRP) - which has a plastic matrix reinforced with glass fibres.

2.1 Complete the sentences using the words in the box. Look at A opposite and Appendix IV on page 104 to help you.

metal non-metal metallic non-metallic ferrous non-ferrous

1 .... Carbon (C) is a
2 .... Copper (Cu) is a metal.
3 .... Aluminium (Al) is a common
4 .... Steel (Fe + C) is a widely used metal.
5 .... Although it is used in steel, carbon is
6 .... Aluminium is relatively lightweight for a ....material.

2.2 Decide whether the sentences below are true or false, and correct the false sentences. Look at B opposite to help you.

1 The elements that make up a compound are chemically bound.
2 Alloys are chemical compounds that are frequently used in engineering.
3 Alloys can contain both metallic and non-metallic constituents.
4 In an alloy, an alloying metal is the biggest constituent, by percentage.
5 Steel is a metallic element.

2.3 Complete the extract about concrete and steel, using suitable forms of the word *reinforce* from C opposite. Sometimes there is more than one possible answer.

(1) .... concrete is one of the most widely used construction materials, and one we take for granted. However, using steel bars to (2) concrete structures located outdoors is only possible thanks to a fortunate coincidence: concrete and steel have practically the same coefficient of thermal expansion - in other words, as atmospheric temperature varies, the concrete and the steel (3)............expand and contract at the same rate, ailowing'unifo'mi movement. Using a (4)........... material with a different coefficient of expansion would not be feasible. For example, (5) aluminium- .... .concrete would quickly .... disintegrate.

2.4 Read the text below and find two elements, two compounds, an alloy and a composite. Look at A, B and C opposite to help you.

Generally, the steel used in reinforced concrete will have previously been exposed to water and to the oxygen in the air. As a result, it will usually be partly corroded, being covered with a layer of iron oxide (rust). However, once the steel is inside the hardened concrete, it will be protected from air and water, which prevents further rusting. Additionally, the cement in concrete does not react aggressively with the iron in steel.

Element	Compound	Alloy	Composite

Over to you

Think of some of the materials used to make products or structures you know about. Say

whether the materials are elements, compounds, mixtures, alloys or composites. If they are composites, what materials are used (a) as the matrix, and (b) as reinforcement?

3 STEEL

A Carbon steels

This extract from an article in an engineering journal is about different types of steel.

Steel is the most widely used engineering material. Technically, though, this well-known alloy of iron and carbon is not as simple as one might think. Steel comes in a huge range of different grades, each with different characteristics. For the inexperienced, it can be difficult, to know where to begin.

A good place to start is with the two main types of steel. The first, carbon steels, consist of iron and carbon, and contain no significant quantities of other metals. Carbon steels can be divided into three main grades:

- Mild steel - the most widely used grade - is a low carbon steel which contains up to approximately 0.3% carbon.
- Medium carbon steel contains between approximately 0.3% and 0.6% carbon.
- High carbon steel contains between approximately 0.6% and 1.4% carbon.

Note: The chemical symbol for iron = Fe, and carbon = C.

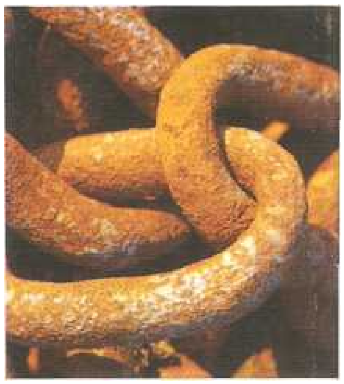
B Alloy steels. The article goes on to kook at alloy steels.

The second main category of steel is alloy steels, which consist of iron, carbon and one or more alloying metals. Specific grades of alloy steel include:

- low alloy steels, which contain 90% or more iron, and up to approximately 10% of alloying metals such as chromium, nickel, manganese, molybdenum and vanadium
- high strength low alloy steels (HSLA), which contain smaller quantities of the above metals (typically less than 2%)
- stainless steels, which contain chromium as well as other metals - such as nickel - and which do not rust.
- tool steels, which are extremely hard, and are used in cutting tools. They contain tungsten and/or cobalt. A widely used grade of tool steel is high-speed steel, which is used in cutting tools that operate at high temperatures, such as drill bits.

Notes: The terms carbon steel and alloy steel can cause confusion, as carbon steels are also alloys, and alloy steels also contain carbon.

C Corrosion



One weakness of mild steel is that it corrodes - its surface progressively deteriorates due to a chemical reaction. This reaction takes place between the iron in the steel and the oxygen (O2) in the air, to form iron oxide. When iron corrodes, we say that it rusts. In some metals, such as aluminium (Al), the presence of corrosion is not a problem, as the layer of oxide around the metal remains hard, which prevents it from oxidizing any further. However, when mild steel goes rusty, the rust on the surface comes off continuously, and a new rusty layer forms, progressively 'eating into' the metal.

3.1 Decide whether the sentences below are true or false, and correct the false sentences. Look at A and B opposite to help you.

1 Steel is an alloy of iron and carbon.
2 Mild steel is a high carbon steel.
3 Alloy steels contain carbon.
4 Chromium and nickel are used as alloying metals in steel.
5 Low alloy steels contain more chromium than iron.
6 Stainless steel is an alloy steel.
7 Tungsten is added to steel to make it softer.
8 High-speed steel is suitable for making cutting tools that get very hot.

3.2 Complete the table with words related to *corrode*, *oxide* and *rust*. Then use the words to complete the sentences below. There is more than one possible answer. Look at C opposite to help you.

Verb	Noun	Adjective
		corroded
		oxidized
/go rusty		

1. When steel is exposed to air and water, it......................
2. A brown/red material on the surface of steel is called....................
3. The strength of steel is reduced if it is ……………………………………….

3.3 Complete the article about a special type of steel, using words from A, B and C opposite

Weathering steel

The perennial problem with mild (1)………………is that it (2)......................when exposed to air and water. Generally, the only solution is either to apply a protective coating, or to use another (3)................ofsteelthat is resistant to the (4.................) process - the most well-known being (5) ....steel, which contains significant quantities of (6)................ and,often,nickel.

There is, however, an alternative solution. So-called weathering steel is a special alloy suitable for outdoor use. But rather than being completely protected from corrosion, the surface of the steel is allowed to go (7)..........
Once a layer of (8)…………………… has formedon the surface, it stabilizes and forms a hard protective layer. This layer differs from ordinary (9)............oxide, as it does not continue to eat into the metal. While not everyone may like the 'rusty look', weathering steel has been widely used in architectural applications and outdoor sculptures.

Over to you

Think about some items you're familiar with that are made of steel, but which are not protected (for example, by paint). How serious is the potential problem of corrosion? How is it prevented or limited - for example, by using a specific grade of steel?

4 NON-FERROUS METALS

A Common non-ferrous engineering metals

These website extracts look at the engineering applications of some **non-ferrous metals** - that is, metals that do not contain iron.

Aluminium is widely used, often in alloy forms. An example is duralumin, an alloy used in aircraft manufacturing, which also contains **copper** (4.4%) and **magnesium** (1.5%). Aluminium can also be alloyed with **titanium** to produce very strong, lightweight metals.
Copper is an excellent electrical conductor, which makes it ideal for use in electric wires. Good ductility also makes it suitable for pipes. Copper is widely used in alloys, notably **brass** (copper and **zinc)** and **bronze** (copper and **tin,** and sometimes **lead).**
Silver is a **precious metal** - a reference to its high cost. It is a better electrical conductor than any other material, so it is often used for electronic connections. Another precious metal - **gold** - is also an excellent conductor, and is highly corrosion-resistant.

Notes: For more on metals and alloys, see Unit 11. For more on ductility, see Unit 18.
The chemical symbol for aluminium = Al, copper = Cu, magnesium = Mg, titanium = Ti, zinc = Zn, tin = Sn, lead = Pb, silver = Ag and gold = Au.

B Plating with non-ferrous metals

Non-ferrous metals can be used to protect steel from corrosion by plating it - that is, covering it with a thin layer of metal. An example is **galvanizing** (zinc plating).
Steel can be **hot-dip galvanized,** by placing it in **molten** (liquid) zinc. It can also be **electrogalvanized,** which is a type of **electroplating.** With this technique, the steel component is placed in a liquid (often an acid) - called the **electrolyte** - and connected to the **negative terminal** (-) of an electrical supply, to become the **cathode** (the negative side). A piece of zinc is also placed in the electrolyte, and is connected to the **positive terminal** (+) of the supply. This then becomes the **anode** (the positive side). An electric current then flows between the pieces of metal, through the electrolyte. This causes a chemical reaction, which deposits zinc on the cathode, plating the component.

A related process, called **anodizing,** is used to protect aluminium. The component to be **anodized** is connected to the positive terminal (to become the anode) and placed in an electrolyte, with a cathode. As electricity flows, **aluminium oxide is** deposited on the anode. As this is harder than aluminium metal, it provides protection.

4.1 Make correct sentences using one part from each column. Look at A opposite to help you. The first one has been done for you.

1 Duralumin	can be mixed with copper to make	silver.
2 Titanium	resists corrosion better than the other precious metal,	brass.
3 Zinc I	has a high strength-to-weight ratio and is often alloyed with	aluminium.
4 Copper	- is an aluminium alloy that also contains copper and	bronze.
5 Gold	can be mixed with tin and lead to produce	magnesium.

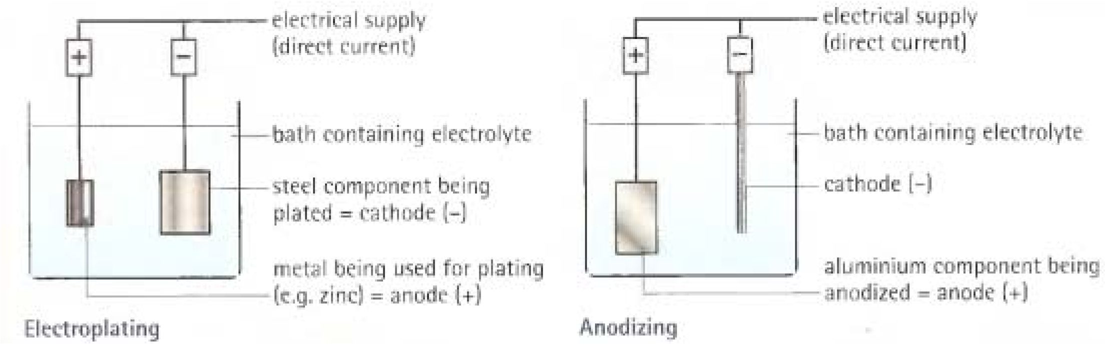
4.2 Complete the word groups below using the names of the metals in 13.1 above. You will need to write some names more than once. Look at A opposite to help you.

Metal elements	
Alloys	
Precious metals	

4.3 Complete the checklist for electroplating using the words in the box. Look at B opposite to help you.

anode	electrolyte	galvanizing	plated
cathode	electroplating	negative	positive

- Check that there is sufficient (1) ……….. in the bath to completely cover the component, in order to ensure that the component will subsequently be (2) ……. over its entire surface area.
- Ensure that the component is connected to the (3)………… terminal of theelectrical supply. During the (4)………….. process, the component should function as the (5)………….
- Ensure that the metal being used for plating - e.g. zinc for (6)……… - is connected to the (7)…………….. terminal of theelectrical supply. During the process, it should function as the (8)…………….



Over to you

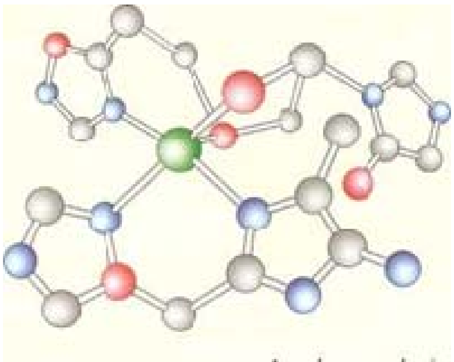
How are non-ferrous metals used in your industry, or an industry you're familiar with? Is electroplating common? If so, what kinds of metals are used for plating, and why are these specific metals chosen?

5 POLYMERS

A Natural and synthetic polymers

The web page below, from a website for engineering students, provides an introduction to polymers.

With names such as polytetrafluoroethyline and polyethyleneteraphthalate, it's not surprising that polymers are usually called by their more common name, plastic. But what, exactly, is a polymer or a plastic? Polymers are compounds made up of several elements that are chemically bound. Most compounds consist of large numbers of tiny m olecules, which each contain just a few atoms. For example, a water molecule - H20 - contains two hydrogen atoms and one oxygen atom. But the molecules of polymers contain huge numbers of atoms, joined together in long chains.



A polymer chain

Rubber, thanks to its many uses from rubber bands to car tyres, is one of the best-known polymers. It comes from latex, a natural liquid which comes from rubber trees. Rubber is therefore a natural polymer. Fiowever, most of the polymers used in industry are not natural, but synthetic. The term 'plastic' is generally used to refer to synthetic polym ers - in other words, those that are manmade.

B Thermoplastics and thermosetting plastics The page goes on to look at types of polymer.

Synthetic polymers can be divided into two main categories:
Therm oplastics can be melted by heat, and formed in shaped containers called moulds. After the liquid plastic has cooled, it sets to form a solid material. A thermoplastic is a type of plastic that can be heated and moulded numerous times. Examples of thermoplastics that are common in engineering include:

- ABS (acrylonitrile butadiene styrene) - stiff and light, used in vehicle bodywork
- polycarbonate - used to make strong, transparent panels and vehicle lights
- PVC (polyvinylchloride) - a cheaper plastic used for window frames and pipes.

Therm osetting plastics, also called therm osets, can be heated and moulded like thermoplastics. They may also be mixed from cold ingredients. Fiowever, during cooling or mixing, a chemical reaction occurs, causing thermosets to cure. This means they set permanently, and cannot be moulded again. If a thermoset is heated after curing, it will burn. Examples of thermosets used in engineering are:

- epoxy resins - used in very strong adhesives
- polyim ides - strong and flexible, used as insulators in some electric cables.

Two more categories of polymer are engineering plastics and elastomers. Engineering plastics are mostly thermoplastics that are especially strong, such as ABS and polycarbonate. Elastomers are very elastic polymers which can be stretched by force to at least twice their original length, and can then return to their original length when the force is removed.

5.1 Circle the correct words to complete the text. Look at A opposite to help you.

A lot of rubber is made from latex, a (1) natural/synthetic polymer which comes from rubber trees. However, not all rubber comes from trees. Synthetic rubber is a (2) manmade/natural polymer with similar properties to latex. Plastics are also polymers. Like rubber, they consist of long chains of (3) atoms/molecules which form extremely large (4) atoms/molecules.

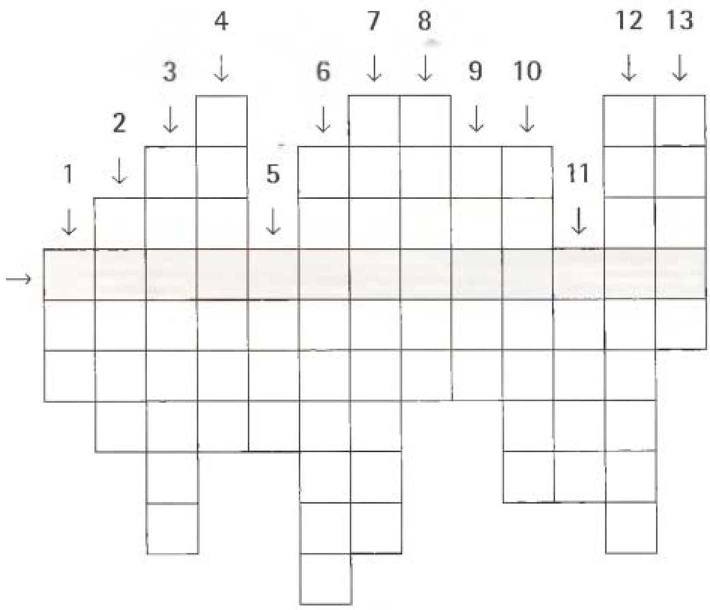
5.2 Read the extract describing a plastic panel manufacturing process. Then decide whether the sentences below are true or false, and correct the false sentences. Look at B opposite to help you.

By this stage of the process, the plastic is solid, and has fully cooled. Selected panels can now undergo quality-control testing, to check they are strong enough to cope with the tough conditions they will be exposed to in use. Tests include tensile testing, where narrow lengths of panel are subjected to high tension loads to check they do not stretch or fracture. More tests are carried out to check the panels' resistance to impacts and scratching. Any products that fail the tests are returned to the beginning of the production process, melted down, and their material is reused.

1 The plastic was heated earlier in the process.
2 The plastic has now set.
3 The plastic is now liquid.
4 To pass one of the tests, the plastic must be an elastomer.
5 The description suggests the plastic is a type of engineering plastic.
6 The material is a thermosetting plastic.
7 The material is a thermoplastic.

5.3 Complete the word puzzle and find the word going across the page. Look at A and B opposite to help you

1 a shorter name for polyvinylchloride
2 used for forming melted plastic
3 a group of atoms
4 a long chain of atoms
5 to set permanently
6 a very elastic polymer
7 a plastic that sets permanently
8 a natural polymer
9 a very strong thermoset resin
10 not natural
11 particles that form molecules
12 another word for 'not natural'
13 material used to make rubber



Over to you

Talk about specific types of polymer that are used in your industry, or an industry you're familiar with. How are they used? Which of the categories mentioned in A and B opposite do the polymers belong to?

6 MINERALS AND CERAMICS

A Mineral and ceramic engineering materials.

A mineral is a natural, inorganic material (one that is not living) which is found in the ground, often within rocks. M inerals are quite pure. R ocks, on the other hand, can be mixtures of several minerals, and may also contain previously organic material. Examples of minerals include different types of ore - from which metal can be extracted - such as iron ore. Non-m etallic minerals include:

- diamond, an extremely hard form of carbon (C), which is used as an abrasive (very hard and rough) material in cutting tools - frequently referred to as industrial diamond when used in engineering
- silicon (Si), found in sand as silica (silicon dioxide - SiCb), which can be heated to high temperatures to make glass.

Generally, inorganic, non-metallic materials that have been formed by heating are called ceramics. Glass is therefore a ceramic. When materials are heated to extremely high temperatures to form ceramics that are glasslike - that is, with a structure like that of glass i - we say that they are vitrified.
I

Ceramic materials are used to make construction materials such as bricks. These are made from clay, and are then fired in a kiln - that is, heated to a high temperature in I I an industrial oven. Clay can also be vitrified - for example, to make w aterproof pipes.

B Glass.

A technical adviser for a glass manufacturer is giving a briefing to a group of engineers at a trade fair. ‘Sheets of glass, which are obviously flat and thin, are called float glass. This refers to the manufacturing technique where molten glass is floated on molten tin, to produce flat sheets. Usually, after float glass has been formed, it’s annealed - it’s left to cool slowly. But if it’s left in this state, and the glass later gets broken, it breaks into dangerous, sharp pieces. So for most engineering and architectural uses, annealed glass is unsuitable. We need to use what we call safety glass.' 'One type of safety glass is toughened glass, also called tempered glass. As the term suggests, the glass is tempered - it’s heated and kept hot for a certain time, to change its structure. Then if tempered glass is broken, it shatters - it breaks into tiny pieces. These are a lot safer than the long, sharp pieces produced when annealed glass breaks. The disadvantage of toughened glass is that it can’t withstand impacts from small objects, such as flying stones. So, for instance, that makes it unsuitable for vehicle windscreens. So in cases where impacts are a problem, another type of safety glass - laminated glass - is generally used. This is made by laminating glass with a polymer - in other words, making a glass and polymer ‘sandwich’, with a sheet of polymer in the middle and sheets of glass at either side. The advantage of having a laminated material is not just that it’s very strong. The layers of glass are bonded to a layer of polymer - they’re stuck to the polymer - so if the glass does break, the broken pieces are held together, and don’t fly.’

6.1 Decide whether the sentences below are true or false. Then, change one word in each of the false sentences to correct them. Look at A opposite to help you.

1 Minerals are organic.
2 Minerals can be found in rocks.
3 Silica is a compound containing silicon.
4 Minerals can be metallic or non-metallic.
5 Industrial diamond is an abrasive, metallic mineral.
6 In order to become ceramics, materials must be vitrified.
7 Clay can be fired to produce material with a glass-like structure.

**6.2 Use the words and expressions in the box to describe each photo. You will need to use some
words more than once. Look at B opposite to help you.**

annealed glass	safety glass	toughened glass
laminated glass	tempered glass	windscreen

1

....

2

....

3

....

6.3 Complete the article about bulletproof glass from a science and technology magazine, using words from B opposite. Sometimes, more than one word is possible.

‘Bulletproof is a loosely used word, suggesting something is totally unbreakable. But technicaEy speaking, how accurate is the term ‘bulletproof glass'? Outside of Hollywood movies, can glass really stop bullets? The answer is, not on its own. But if several (1)...........................of glass are sandwiched with a high-strength polymer to form (2)..........................glass, a bullet-resistant, if not completely bulletproof, barrier can be obtained. The technique of sandwiching polymer and glass is nothing unusual. Car windscreens are made by (3) glass to a polymer, such as polyvinyl butyral (PVB), to form a type of safety glass. Unlike the other main type of safety glass -

(4)...........................glass - laminated glass remains intact on breaking. If a stone hits a windscreen, even though a small section of the glass on the outside may crack, the polymer behind it will stop the stone, and also ensure the entire piece of glass doesn't (5)............................ BuEet-resistant glass uses the same principle, but must be much tougher. A stronger polymer is therefore used - often polycarbonate - as weE as a greater number of (6)...........................of glass and polymer.

Over to you

Think about the different ceramics and minerals used in your industry, or in an industry you're familiar with. What types of material are used, and why?

7 CONCRETE

A Concrete mix design

Cement

Sand – fine aggregate

Gravel – coarse aggregate

Cement is a key material in construction. It consists of a very fine powder. When water is added to cement, a chemical reaction occurs, and the cement begins to set - it starts to become solid. The most widely used cement-based material is concrete, which is made from cement, fine aggregate (sand), coarse aggregate (gravel) and water. After concrete has set, it needs time to reach its structural strength - the strength needed to perform effectively. Generally, engineers consider that this strength is reached after 28 days - a point called 28-day strength.

Concrete mix designs, which are specified by engineers, state the proportions of cement, fine aggregate and coarse aggregate to be used for specific structures. For example, a 1:2:4 (onetwo-four) mix consists of one part cement, two parts fine aggregate and four parts coarse aggregate. For mixing precise quantities - known as batching - proportions are measured by weight. Mix designs also specify the water-cement ratio - the amount of water added relative to the amount of cement used. Excess water reduces the strength of concrete, so the quantity of water is kept to a minimum. But as drier concrete is more difficult to work with, an additive (added chemical substance) called a plasticizer is often used. This helps the concrete to flow more easily. Other additives can also be used - for example, a retarder may be added , to delay setting, which gives workers more time to pour (place) the concrete.

B Reinforced concrete

Reinforced concrete (RC) structures contain steel bars. Steel reinforcement is needed mainly because concrete is weak in tension - that is, bad at resisting stretching forces. As steel is strong in tension, reinforcing bars overcome this weakness. In order to form the different parts of structures, formwork - sometimes also called shuttering - is used. This consists of moulds of the required size and shape, made from steel or timber, which are used to contain the concrete until it has set. In-situ reinforced concrete being poured
When wet concrete is cast (placed) in its final position, it is called in-situ concrete. Instead of being cast in-situ, reinforced concrete elements can also be precast - cast at a factory - then delivered to the construction site ready for assembly. Sometimes, precast concrete is also prestressed. With prestressing, tension is applied to the reinforcing bars, by machine, usually before the concrete is poured. The bars are then held in tension while wet concrete is poured around them. After the concrete has fully set, the bars become 'trapped' in tension. This increases the concrete's ability to resist bending forces.

7.1 Find words and expressions in A opposite to match the descriptions (1 -10)

1 gravel used in concrete ....
2 sand used in concrete ....
3 powder that enables concrete to set ....
4 mixing concrete accurately ....
5 specification of concrete ingredients ....
6 effective structural capability of concrete ....-.........................
7 affects the wetness and strength of concrete ....
8 different types of chemical put in concrete ....
9 allows concrete to stay wet for longer ....
10 makes drier concrete easier to work with ....

7.2 Complete the textbook extract about a type of prestressed concrete using the words in the box. Look at B opposite to help you.

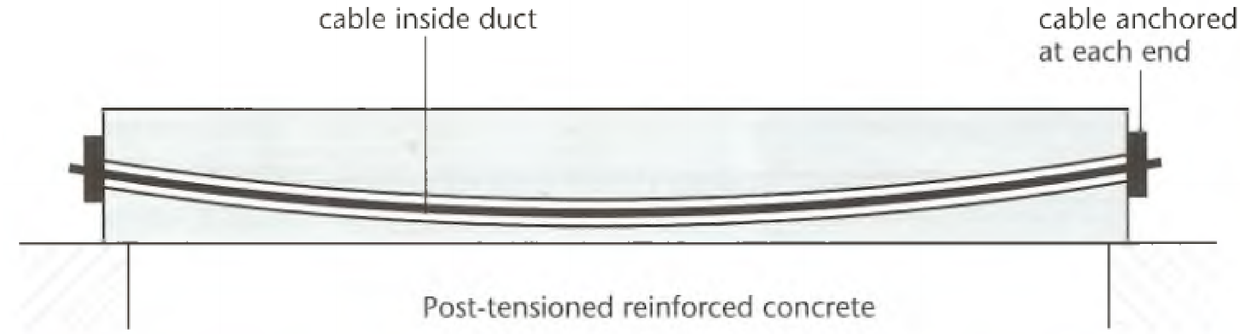
cast	formwork	pouring	prestressing	structural
concrete	in-situ	precast	reinforcement	

Prestressing techniques

In the production of reinforced concrete components, the process of (1)........................ usually involves holding the (2)........................in tension while (3).......................... the concrete. This form of prestressing is called pre-tensioning, as tension is applied before the concrete is poured. The technique is often used in the manufacture of floor components, which are small enough to fit on the back of a truck, and can therefore be (4)........................at a factory.
A less common prestressing technique is post-tensioning (applying tension offer the concrete has set). This is more suitable for large elements, especially long beams, which cannot be transported, and therefore need to be poured (5)..........................Before the concrete is poured, ducts (usually plastic tubes) are placed inside the (6)........................ along the length of the beam. These ducts contain steel cables. After the concrete has been (7)........................and has

gained sufficient (8).........................strength, the cables are put in tension, using jacks at either

end of the beam. This is only possible because the cables are free to move within the ducts - it is not possible with pre-tensioned
reinforcing bars, which are held fast by the hard (9)........................surrounding them. The ends of the cables are then permanently anchored at either end of the beam.



Over to you

Think about a reinforced concrete structure in your area - for example, a building or a bridge. In what sequence do you think it was built? Do you think it was poured in-situ, or were its parts precast?

8 WOOD

A Categories of wood

The two main categories of wood are:
■I hardwood - usually from deciduous trees, which lose their
leaves in autumn, although some hardwood (for example, gram
tropical hardwood) comes from other types of tree
■ softwood - from coniferous trees, which remain green throughout the year.
In engineering, wood can be categorized as:
■ solid wood - softwood or hardwood that has been sawn into specific shapes and sizes, but whose natural structure, consisting of grain and knots, remains intact
■ engineered wood - made by bonding (sticking together) layers of solid softwood or hardwood, or by mixing quantities of wood particles and bonding them with resin.
Notes: In industry, wood is often referred to as timber (BrE) or lumber (AmE).
In American English, timber generally means wood that is still growing in trees.
Knot is pronounced /not/ (the k is silent).

B Solid structural timber

The text below is from a technical handbook about structural timber - wood intended to support loads in a structure.

Generally, timber is cut to the required section - the width and depth that determine its crosssection
- at a sawmill, where a range of section sizes are produced. Timber from sawmills is generally

supplied in rough-sawn sections. This refers to the surface texture produced by sawing timber with a circular saw. If the timber needs to have a smooth finish - for example, because it will be visible in the structure - it can subsequently be planed to smooth its surface.
Because the strength of wood varies, structural timber must be stress-graded. This means its strength is tested in order to give it a stress grade - a standard strenqth value which an engineer can use for design calculations. Timber can be mechanically stress-graded, where its strength 4 is checked by machine. It can also be visually stress-graded, where the wood is examined by an inspector who looks for potential weaknesses - in particular, the position of knots.

C Engineered wood

Engineered wood covers a range of softwood and hardwood materials. It includes:
■ cheap, low-strength boards, such as particle board (often called chipboard) and mediumdensity fibreboard (MDF)
■ stronger boards suitable for structural use - primarily orientated strand board (OSB), which is made from strands of wood bonded with resin, and plywood, which consists of several plies (layers) of solid wood, bonded so that the grain of each ply runs at 90 degrees to that of the adjacent plies, to provide increased strength
■I glue-laminated sections - sometimes called glulams - which can be used as major structural elements, such as beams, in large buildings.


Particle board or chipboard


Orientated strand board (OSB)


Plywood

8.1 M atch the two parts to make correct sentences about wood. In each case, there is more than one possible answer. Look at A opposite to help you.

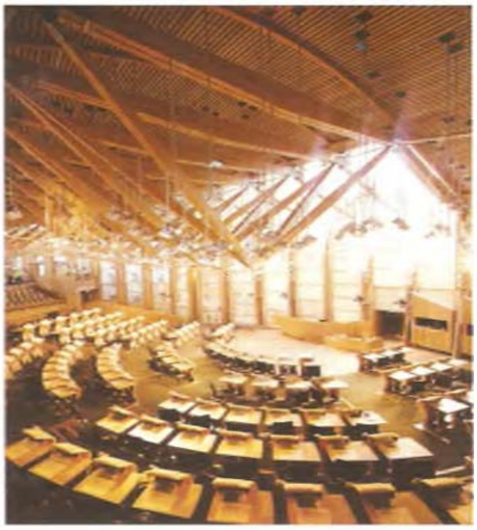
1 Engineered wood
2 Softwood
3 Solid wood
a comes only from coniferous trees,
b comes only from deciduous trees,
e can come from either coniferous or deciduous trees.
d specifically describes single pieces of timber, not multiple pieces that have been bonded together.
e is always made from multiple pieces or particles of wood,
f may have knots in it.

8.2 Complete the sentences below using words and expressions from B opposite.

1 Wood has a smooth finish after it has been ....
2 Wood cut with a circular saw is called...timber.
3 After timber is tested for strengths and weaknesses, it is given a ....
4 When timber is inspected by a person who looks for weaknesses, it is...................................
5 When timber is inspected by a machine which tests its strength, it is………………………..

8.3 Complete the article about the environmental considerations of wood using words from B and C opposite.

From an environmental perspective, wood has many dvantages. Firstly, it comes from a sustainable source. Coniferous trees grow relatively fast, providing a rapidly replaceable source of (1).............................Secondly, almost all the timber in a tree can be utilized, leaving little or no waste. The best quality wood can be used for structural applications, where solid, (2) ………..sections are required are required by engineers; for high-strength elements such as (3) …………………beams; and in the high-quality plies used to make (4).............................Smaller strands can be made into engineering wood with structural properties, such as (5)...........................
And small particles and fibres, including those from waste timber, can go into cheaper materials, like (6)…………………….. board and(7)……………………



Glue-laminated timber in the Scottish Parliament building in Edinburgh, Scotland

Over to you

What types of timber are used in your home and/or office, both as building materials and to make fixtures and furniture within the building.

9

MATERIAL PROPERTIES 1

A

Tensile strength and deformation.

When materials are exposed to forces, such as tension (stretching forces < — □ —>) and compression (crushing forces —> □ <—), they deform - that is, they change shape. The type of deformation depends on the type of force that is applied.
When a material is subjected to tension, its length will increase by a certain amount. This is called extension or elongation. It is especially important to understand the performance of materials in tension, as their tensile strength (ability to resist tension) is usually lower than their compressive strength (ability to resist compression).

B

Elasticity and plasticity.

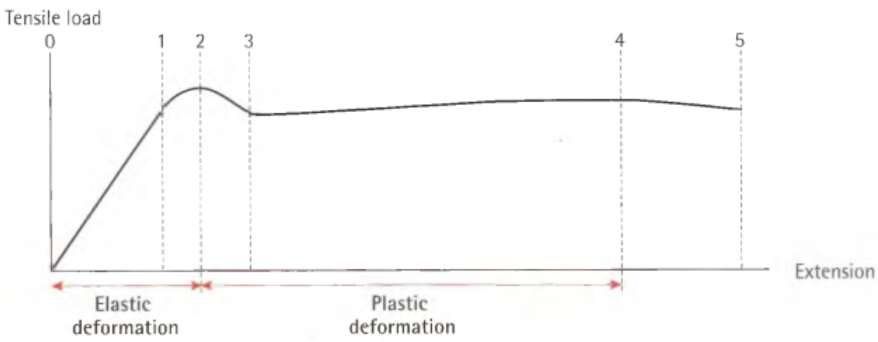
Some materials can extend significantly, but still return to their original shape. A m aterial’s ability to do this is called elasticity. Rubber is an example of a very elastic material - it can be elastically deformed to a considerable extent. If a material has very low elasticity, and is strong, engineers say it is stiff. If a material has low elasticity and is weak, it is described as brittle - that is, it fractures (breaks, due to tension) very easily. Glass is an example of a brittle material. Some materials can change shape significantly, but do not return to their original shape. We say these materials are plastic. Often, plasticity is described in specific terms. A material that can be plastically deformed by hammering or rolling - for example, lead (Pb) - is malleable. A material that can be drawn out (stretched) into a long length - for example, copper (Cu) - is ductile.

C

Stages in elastic and plastic deformation.

The graph below shows the typical extension behaviour of ductile materials in tensile testing - where a sample bar is subjected to a progressively increasing tensile force.

Points 0 -1	The extension of the bar is proportional to the increase in tension. For example, when tension increases by 10 % , length increases by 10% .
Point 1	The bar reaches the limit of proportionality. Beyond this point, length begins to increase at a slightly greater rate than tension.
Point 2	The elastic limit is reached. Beyond this point, the bar will no longer return to its original length. In many materials, the elastic limit occurs almost immediately after the limit of proportionality.
Point 3	The bar reaches its yield point. Once it yields, it continues to increase in length, even without a further increase in tension.
Point 4	This is the ultimate tensile strength (UTS) of the material. Beyond this point, a waist (a narrower section) appears at a point along the length of the bar, signalling that it is about to fracture.
Point 5	This is the fracture point, where the bar breaks in two.



9.1 Complete the sentences using the words in the box. You will need to use one word twice.
Look at A opposite to help you.

compression	deformation	elongation	extension	tension

1 A stretching force is called............................
2 A crushing force is calle d ....
3 Extension is also called ....
4 Tension cau ses...........................o r.............................
5 Tension or compression cau se............................

9.2 Match the two parts to make correct sentences. Look at B and C opposite to help you.

1 If a material is stiff
2 If a material is brittle
3 If a material is plastic
4 If a material yields
5 If a material fractures
6 If a material is elastically deformed

a it is malleable and/or ductile.

b it has low elasticity and low tensile strength.

c it has low elasticity and high tensile strength.
d it has been extended to a point before its elastic limit.
e it has been loaded beyond its ultimate tensile strength.
f it has been significantly plastically deformed, but not broken.

9.3 Complete the magazine article about springs using words from A, B and C opposite

How are the springs used in car suspension made springy? It sounds like a silly question, but think about it for a moment. In order for a spring to compress or extend, then return to its original shape, it must be (1)......... But springs are made from wire, and wire is made from very (2)……….. metal (often cold drawn carbon steel). When tne wire is manufactured, it is not only stretched beyond its (3).. - meaning it will no longer return to its original length - but also beyond its (4).., where significant, irreversible (5)........................ occurs. The metal from which springs are made has therefore been (6)……….. deformed and, consequently, needs to have its springiness put back. To do this, once a spring has been formed into a coil, it is tempered - a process in which it is heated
and kept at a high temperature for a sustained period. This 'resets' the atomic structure of the metal (partly, at least), so that after tempering, the spring will behave as it should - it can be (7).....................deformed and will subsequently return to its original shape.

Over to you

Think about a device, vehicle or structure you're familiar with, and the materials used to -makke it. What properties do the materials have? Which properties are strengths in this situation? Which properties are weaknesses, and how are these weaknesses overcome?

10 MATERIAL PROPERTIES 2

A Hardness.

The hardness of a material affects its durability - that is, how long it will last. Generally, hard materials are more durable than soft materials, because they are better at resisting wear - progressively worsening damage - to their surfaces. Hardness can be defined in two main ways:

■ Scratch hardness describes a material's ability to resist being scratched. Materials with a high degree of scratch hardness are said to have good abrasion resistance - they are good at resisting damage due to abrasion (the action of two surfaces being rubbed together).
■ Indentation hardness describes a material's ability to resist indentations - that is, compressions in the surface of a material caused by impacts.


Scratches


Indentations

B

Fatigue, fracture toughness and creep. The article below is from an aviation magazine.
In aircraft construction, special attention must be paid to two materials problems that are well understood by mechanical and structural engineers. One is fatigue, often called metal fatigue in metals. This problem is caused by cyclic loads - forces that continually vary. In aircraft, the wings are affected by cyclic loading as they frequently flex, continually bending up and down due to air turbulence. The consequence of fatigue is micro-cracking - the formation of cracks too small to see with the eye, and which worsen over time. The speed at which fatigue cracking progresses depends on the material's fracture toughness. This is a measure of how easily cracks that have already formed continue to open up and increase in length. Another problem is creep - where components become permanently deformed (stretched, for example), due to loads. Creep increases over time. The problem is made worse by heat, so is a major issue in engines, where both loads and temperatures are high.

C

Basic thermal properties.

Some materials conduct (carry or transmit) heat better than others. Therefore, thermal conductivity varies, depending on the material. Copper, for example, is an excellent thermal conductor. Polystyrene, on the other hand, is an excellent thermal insulator (and so a very poor thermal conductor).
As temperature increases, most materials expand (increase in size due to heating), and as temperature falls, they contract (decrease in size due to cooling). The extent to which expansion and contraction occur is measured by a material's coefficient of thermal expansion - that is, its change in size for a given change in temperature. The coefficient for aluminium, for example, is 0.0 0 0 0 2 3 . This means that for an increase in temperature of one degree Celsius, a one-metre length of aluminium will increase in length by 0.000023 metres. This figure can also be referred to as the coefficient of linear expansion, since it describes change in length (a linear measurement).

10.1 Complete the design brief for part of a cutting machine using four of the words in the box.
Look at A opposite to help you.

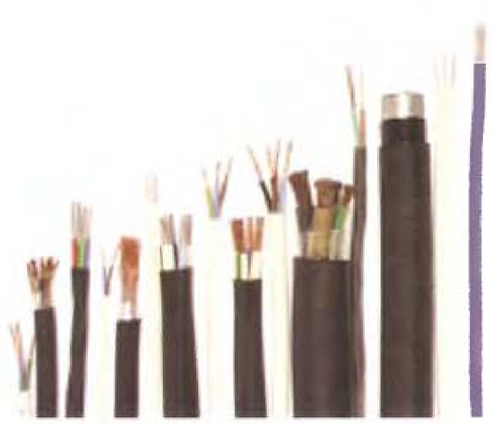
abrasion	durability	durable	hard	indentation	scratch	soft

The cutting wheel will be surrounded by transparent guards. These will allow the operator to see the cutting wheel at all times, and will shield the operator from flying metal fragments. The guards must therefore be constructed from material with a high degree of (1)………… hardness, to protect it from impacts. As the guards will require regular cleaning, the action of wiping away metal fragments will result in (2)………… . The guards must, therefore, have sufficient (3) .... hardness in order to retain their transparency and ensure adequate(4)……………… .

10.2 M atch the descriptions (1-4) to the technical terms (a-d). Look at B opposite to help you.

1 the cause of fatigue	a creep
2 the consequence of fatigue	b cyclic loads
3 a material property that helps to slow down cracking	c micro-cracking
4 permanent changes in shape due to the action of loads over time	d fracture toughness

10.3 Complete the extract from an electrical design handbook using words and expressions from C opposite.



When comparing copper and aluminium as materials for electrical wires, it is necessary to consider their thermal properties. For instance, in situations where high temperatures are involved, it is important to understand how quickly wires (1)......................... heat along their length - for example, away from hot parts, such as motors, towards heat-sensitive electrical components. In this regard, the (2).........................of copper is roughly 40% greater than that of aluminium, so copper is a much more effective (3)........................ In the example above, a designer might therefore prefer aluminium wiring over copper wiring. Another issue is thermal movement - the extent to which the metals (4).........................when heated, and (5) as they cool. In situations where temperature continually rises and falls, the resulting (6)........................ and (7).......................... can be problematic, as it can cause mechanical electrical connections to loosen over time, in this regard, copper has a (8)........................ approximately 40% lower than that of aluminium. Copper therefore has the advantage in this respect, as it is less susceptible to movement.

Over to you

For a product you know about, say what the designer needed to consider with regard to:

- **abrasion**
- **indentations**
- **fatigue**
- **creep**
- **thermal issues.**

What materials were chosen as a result of these considerations?

Список використаної літератури

1. Англійська мова: навч. посіб. / [С.Г. Заскалєта, О. В. Артюхова, К. В. Тішечкіна та ін.]. – Миколаїв: МДАУ, 2012. – 325 с.
2. Cambridge Preparation for the TOEFL Test. Fourth Edition. – Cambridge: University Press, 2011. – 367 p.
3. Michael Swan. How English Works. A grammar Practice Book / M. Swan, C. Walter. – Oxford: University Press, 2012. – 315 p.
4. Загнітко А. П. Великий сучасний англо-український та українсько-англійський словник/ А. П. Загнітко, І. Г. Данелюк. – Донецьк: ТОВ ВКФ «БАО», 2008. – 1008с.
5. Ashly A. Commercial Correspondence / A. Ashly. Oxford: University Press, 2008. – 267p.
6. Rebecca Chapman. English for Emails. Express Series / R. Chapman. – Oxford: University Press, 2001. – 139 p.
7. Wolker H. Paul C. J. Rowlinson, Verlag TH. Mann. Diseases and Pets of Rape. Gelsenthirchen. – Buer, 2002. – 215 p.
8. Артюхова В. О. Англійська мова: методичні рекомендації для оформлення ділової документації для студентів-магістрів денної форми навчання. / О. В. Артюхова. – Миколаїв, 2011. – 69 с.
9. Marius Misztal. Test in Correspondence. Thematic Vocabulary. / M. Misztal. – K., 2006. – 165 p.
10. Mark Obbotson. Cambridge English for Engineering / M. Obbotson. – Cambridge: University Press, 2008. – 112 p.
11. Кухарська В. Б. Анлійська мова для студентів харчових спеціальностей / В. Б. Кухарська. – К.: Фірма «ІНКОС», 2007. – 352 с.
12. Prodromou Luke. Grammar and Vocabulary for the First Certificate / L. Prodromou. Essex: Longman,2000. – 124 p.
13. Harris Michael. Opportunities: in 5 volumes Pre-Intermediate / M. Harris, D. Mover, A. Sikorzynka. – Essex: Longman, 2002. – 172 p.
14. McCarthy Michael. English Vocabulary in Use. Upper-Intermediate and Advanced / M. McCarthy, F. Odell. – Cambridge^ University Press, 2011. – 174 p.

Навчальне видання

Англійська мова:

методичні рекомендації та навчальний матеріал

Укладач: **Артюхова Олена Вікторівна**

Формат 60х84 1/16. Ум. друк. арк. 13,14.
Тираж 30 прим. Зам. №__

Надруковано у видавничому відділі
Миколаївського національного аграрного університету
54020, м. Миколаїв, вул. Паризької Комуни,9

Свідоцтво суб’єкта видавничої справи ДК № 4490 від 20.02.2013 р.