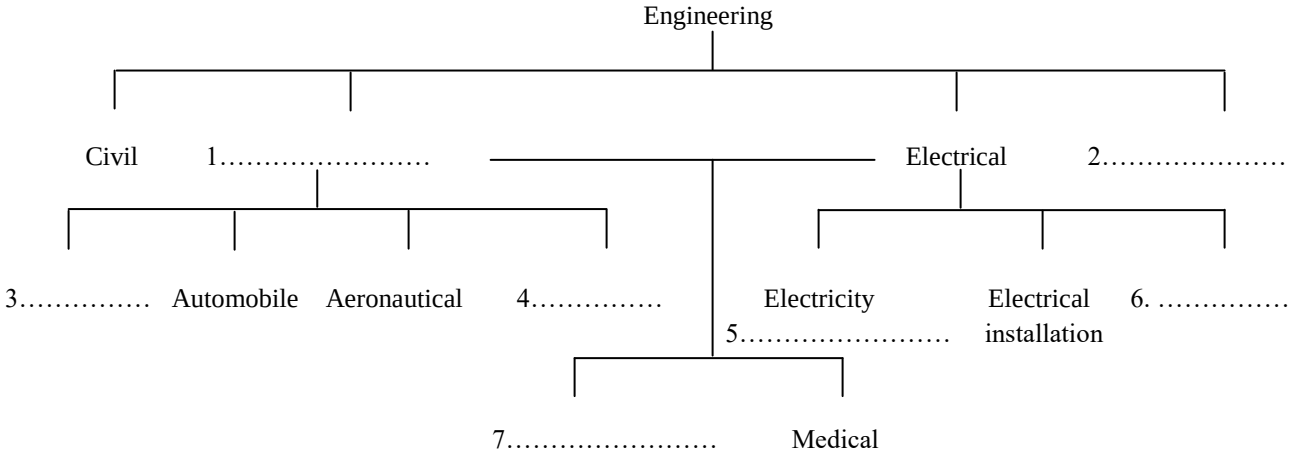
UNIT 1. ENGINEERING - WHAT'S IT ALL ABOUT?

Task 1. List the main branches of engineering. Combine your list with others in your group. Then read this text to find out how many of the branches listed are mentioned.

Engineering is largely a practical activity. It is about putting ideas into action. Civil engineering is concerned with making bridges, roads, airports, etc. Mechanical engineering deals with the design and manufacture of tools and machines. Electrical engineering is about the generation and distribution of electricity and its many applications. Electronic engineering is concerned with developing components and equipment for communications, computing, and so on.

Mechanical engineering includes marine, automobile, aeronautical, heating and ventilating, and others. Electrical engineering includes electricity generating, electrical installation, lighting, etc. Mining and medical engineering belong partly to mechanical and partly to electrical.

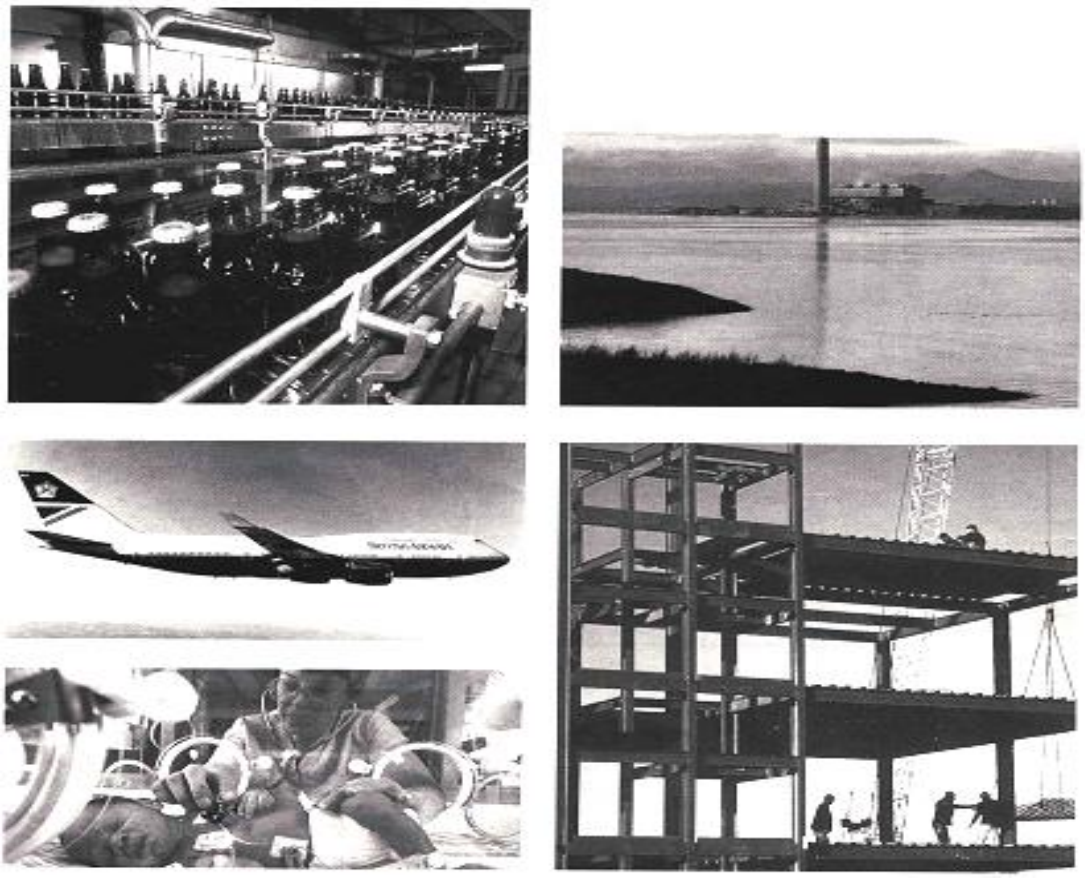
Task 2. Complete the blanks in this diagram using information from the text.



READING *Introduction*

In your study and work. It is important to think about what you are going to read before you read. This help you to link old and new knowledge and to make guesses about the meaning of the text. It is also important to have a clear purpose so that you choose the best way to read. In this book, you will find tasks to make you think before you read and tasks to help you to have a clear purpose when you read.

Task 3. Study these illustrations. They show some of the areas in which engineers work. Can you identify them? What kinds of engineers are concerned with these areas - electrical, mechanical, or both?



Task 4. Now read the following texts to check your answers to Task 3. Match each text to one of the illustrations above.

Transport: Cars, trains, ships, and planes are all products of mechanical engineering. Mechanical engineers are also involved in support services such as roads, rail track, harbours, and bridges.

Food processing: Mechanical engineers design, develop, and make the machines and the processing equipment for harvesting, preparing and preserving the foods and drinks that fill the supermarkets.

Medical engineering: Body scanners, X-ray machines, life-support systems, and other high tech equipment result from mechanical and electrical engineers combining with medical experts to convert ideas into life-saving and life-preserving products.

Building services: Electrical engineers provide all the services we need in our homes and places of work, including lighting, heating, ventilation, air-conditioning, refrigeration, and lifts.

Energy and power: Electrical engineers are concerned with the production and distribution of electricity to homes, offices, industry, hospitals, colleges and schools, and the installation and maintenance of the equipment involved in these processes.

Source: Adapted from *Turning ideas into action*, Institution of Mechanical Engineers, and *Engineering a Career*, Institution of Electronics and Electrical Incorporated Engineers.

LANGUAGE STUDY *deals / is concerned with*

What is the link between column **A** and column **B**

A	**B**
Mechanical	machine
Electrical	electricity

Column **A** lists a branch of engineering or a type of engineer. Column **B** lists things they are concerned with. We can show the link between them in a number of ways:

1. Mechanical engineering deals with machines.
2. Mechanical engineers deals with machines.
3. Mechanical engineering is concerned with machines.
4. Mechanical engineers are concerned with machines.
5. Machines are the concern of mechanical engineers.

Task 5. Match each item in column **A** with an appropriate item from column **B** and link the two in a sentence.

A	**B**
1. marine	a. air-conditioning
2. aeronautical	b. roads and bridges
3. heating and ventilating	c. body scanners
4. electricity generating	d. cables and switchgear
5. automobile	e. communications and equipment
6. civil	f. ships
7. electronic	g. planes
8. electrical installation	h. cars and trucks
9. medical	i. power stations

WORD STUDY *Word stress*

Words are divided into syllables. For example:

engine	en.gine
engineer	en.gin.eer
engineering	en.gin.eer.ing

Each syllable is pronounced separately, but normally only one syllable is stressed. That means it is said more slowly and clearly than the other syllables. We say ‘engine but engin’eer. A good dictionary will show the stressed syllables.

Task 6. Mark the stressed syllables

1. machinery
2. mechanical
3. machine

4. install
5. installation
6. electricity
7. electrical
8. electronics
9. aeronautical
10. ventilation

WRITING

Fill in the gaps in the following description of the different branches of engineering using information from the diagram in Task 2 and language you have studied.

The main branches of engineering are civil. (1)……, (2)……, and electronic. Mechanical engineering is (3)…… (4)…… machinery of all kinds. This branch of engineering includes (5)……,automobile, (6)……, and heating and ventilating. The first three are concerned with transport: (7)……, cars and planes. The last (8)…… with air-conditioning, refrigeration, etc.

Electrical engineering deals with (9)…… from generation to use. Electricity generating is concerned with (10)…… stations. Electrical installation deals (11)…… cables, switchgear, and connecting up electrical equipment.

Two branches of engineering include both (12)…… and (13)…… engineers. These are mining and (14)…… engineering. The former deals with mines and mining equipment, the latter with hospital (15)…… of all kinds.

UNIT 2. ENGINEERING MATERIALS

Task 1. List the materials you know which are used in engineering. Combine your list with the others in your group and classify the materials as metal, thermoplastics…

READING *Scanning tables*

Task 2. Scan the table which follows to find a material which is:

	Properties	**Materials**
1.	Soft	.....
2.	Ductile	.....
3.	Malleable	.....
4.	Tough	.....
5.	scratch-resistant	.....
6.	conductive and malleable	.....
7.	durable and hard	.....
8.	stiff and brittle	.....
9.	ductile and corrosion-resistant	.....
10.	heat-resistant and chemical-resistant	.....

Materials	**Properties**	**Uses**
Metals		
Aluminium	Light, soft, ductile, highly conductive, corrosion-resistant.	Aircraft, engine components, foil, cooking utensils
Copper	Very malleable, tough and ductile, highly conductive, corrosion-resistant.	Electric wiring, PCBs, tubing
Brass (65% copper, 35% zinc)	Very corrosion-resistant. Casts well, easily machined. Can be work hardened. Good conductor.	Valves, taps castings, ship fittings, electrical contacts
Mild steel (iron with 0.15% to 0.3% carbon)	High strength, ductile, tough, fairly malleable. Cannot be hardened and tempered. Low cost. Poor corrosion resistance.	General purpose
High carbon steel (iron with 0.7% to 1,4% carbon)	Hardest of the carbon steels but less ductile and malleable. Can be hardened and tempered.	Cutting tools such as drills, files, saws
Thermoplastics		
ABS	High impact strength and	Safety helmets, car

	toughness, scratch-resistant, light and durable	components, telephones, kitchenware
Acrylic	Stiff, hard, very durable, clear, can be polished easily. Can be formed easily.	Aircraft canopies, baths, double glazing
Nylon	Hard, tough, wear-resistant, self- lubricating.	Bearings, gears, casings for power tools
Thermosetting plastics		
Epoxy resin	High strength when reinforced, good chemical and wear resistance.	adhesives, encapsulation of electronic components
Polyester resin	Stiff, hard, brittle. Good chemical and heat resistance.	Moulding, boat hulls and car bodies
Urea formaldehyde	Stiff, hard, strong, brittle, heat-resistant, and a good electrical insulator.	Electrical fittings, adhesives

Task 3. Scan the table to find

Uses	Materials
1. A metal used to make aircraft	
2. Plastics used for adhesives	
3. Steel which can be hardened	
4. An alloy suitable for castings	
5. A plastic with very low friction	
6. A material suitable for a safety helmets	
7. A metal suitable for a salt-water environment	
8. A metal for general construction use but which should be protected from corrosion	
9. A plastic for car bodies	
10. The metal used for the conductors in printed circuit boards	

LANGUAGE STUDY *Making definitions*

Study these facts from the table about aluminium:

1 Aluminium is a light metal.

2 Aluminium is used to make aircraft.

We can link these facts to make a definition of aluminium:

1+2 Aluminium is a light metal ***which*** *is used to make aircraft.*

Task 4. Choose the correct information in columns B and C to describe the materials in column A.

A	B	C
1. An alloy		allows heat or current to flow easily
2. A thermoplastic		remains rigid at high temperatures
3. Mild steel		does not allow heat or current to flow easily
4. A conductor	a metal	contains iron and 0.7% to 1.4% carbon
5. An insulator	a material	becomes plastic when heated
6. High carbon steel	an alloy	contains iron and 0.15% to 0.3% carbon
7. Brass		formed by mixing metals or elements
8. A thermosetting plastic		consists of copper and zinc

WRITING *Adding information to a text*

Study this text about aluminium.

Aluminium is used to make aircraft, engine components, and many items for the kitchen.

We can add information to the text like this:

Aluminium, ***which is light, soft, and duclile****, is used to make aircraft, engine components -* ***for example, cylinder heads*** *- and many items for the kitchen,* ***such as pots****.*

Note that the extra information is marked with commas or dashes:

, which …,

- for example, … -

, such as…,

Task 5. Add this extra information to the following text about plastics.

1. Plastics can be moulded into plates, car components, and medical aids.
2. Thermoplastics soften when heated again and again.
3. Thermosetting plastics set hard and do not alter if heated again.
4. ABS is used for safety helmets.
5. Nylon is self-lubricating.
6. Nylon is used for motorized drives in cameras.
7. Acrylic is a clear thermoplastic.
8. Acrylic is used for aircraft canopies and double glazing.
9. Polyester resin is used for boat and car bodies.
10. Polyester resin is hard and has good chemical and heat resistance.

Plastics are synthetic materials. They can be softened and moulded into useful articles. They have many applications in engineering. There are two types of plastics: thermoplastics and thermosetting plastics.

ABS is a thermoplastic which is tough and durable. Because it has high impact strength, it has applications where sudden loads may occur.

Nylon is a hard, tough thermoplastic. It is used where silent, low-friction operation is required.

Acrylic can be formed in several ways. It is hard, durable, and has many uses.

Polyester resin is a thermosetting plastic used for castings. It has a number of useful properties.

UNIT 3. THE ELECTRIC MOTOR.

Task 1. Working in your group, list as many items as you can in the home which use electric motors. Which room has the most items?

READING *Skimming*

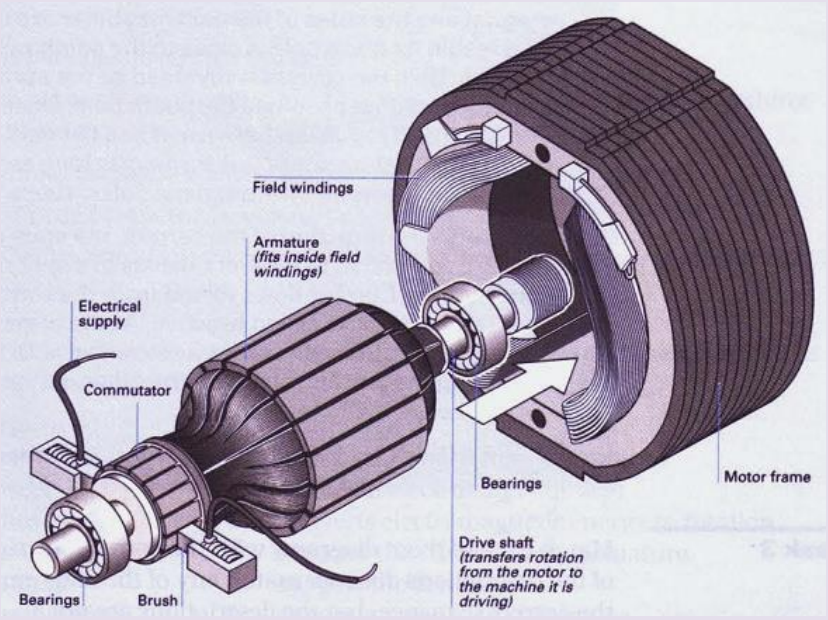
In Unit 2 you studied scanning - locating specific information quickly. Another useful strategy is reading a text quickly to get a general ides of the kind of information it contains. You can then decide which parts of the text are worth reading in more detail later, depending on your reading purpose. This strategy is called *skimming*.

Task 2. Skim this text and identify the paragraphs which contain information on each of these topics. The first one has been done for you.

a. What electric motors are used for *paragraph 1*
b. The commutator ……
c. Why the armature turns ……
d. Electromagnets ……
e. Effect of putting magnets together ……
f. The armature ……

In an electric motor an electric current and magnetic field produce a turning movement. This can drive all sorts of machines, from wrist-watches to trains. The motor shown in Fig. 1 is for a washing machine. It is a universal motor, which can run on direct current or alternating current.

An electric current running through a wire produces a magnetic field around the wire. If an electric current flows around a loop of wire with a bar of iron through it, the iron becomes magnetized. It is called an electromagnet; one end becomes a north pole and the other a south pole, depending on which way the current is flowing around the loop.



If you put two magnets close together, like poles - for example, two north poles - repel each other, and unlike poles attract each other.

In a simple electric motor, like the one shown in Fig. 2, a piece of iron with loops of wire round it, called an armature, is placed between the north and south poles of a stationary magnet, known as the field magnet. When electricity flows around the armature wire, the iron becomes an electromagnet.

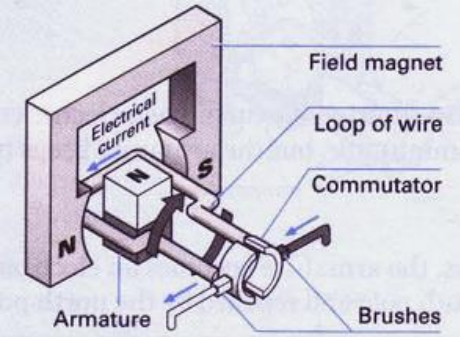


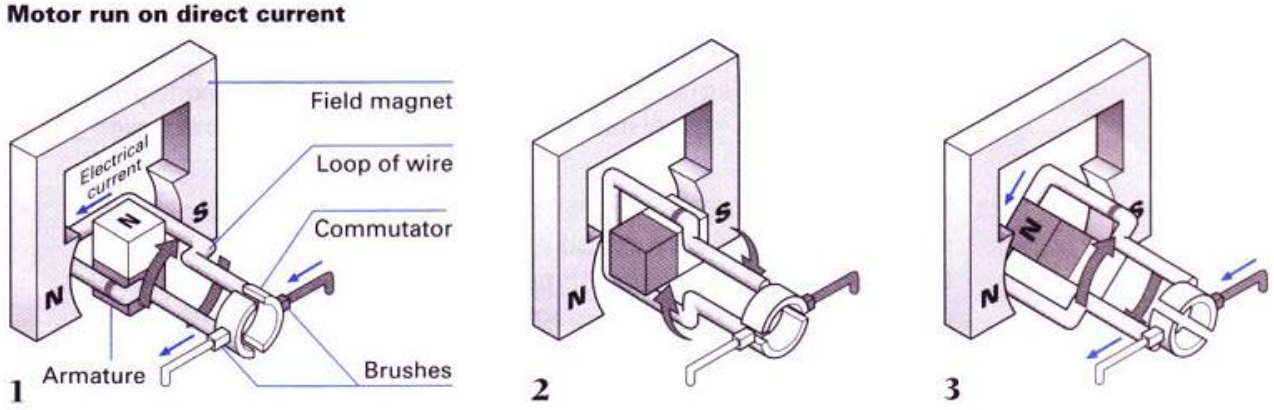
Fig. 2

The attraction and repulsion between the poles of this armature magnet and the poles of the field magnet make the armature turn. As a result, its north pole is close to the south pole of the field magnet. Then the current is reversed so the north pole of the armature magnet becomes the south pole. One again, the attraction and repulsion between it and the field magnet make it turn. The armature continues turning as long as the direction of the current, and therefore its magnetic poles, keeps being reversed.

To reverse the direction of the current, the ends of the armature wire are connected to different halves of a split ring called a commutator. Current flows to and from the commutator through small carbon blocks called brushes. As the armature turns, first one half of the commutator comes into contact with the brush delivering the current, and then the other, so the direction of the current keeps being reversed.

Source: Adapted from 'Inside out: Electric motor', Education Guardian

Task 3. Match each of these diagrams with the correct description, **A**, **B**, **C**, or **D**. One of the descriptions does not match any of the diagrams. (The diagrams are in the correct sequence, but the descriptions are not.)



A

The armature turns a quarter of a turn. Then electric contact is broken because of the gap in the commutator, but the armature keeps turning because there is nothing to stop it.

B

When current flows, the armature becomes an electromagnet. Its north pole is attracted by the south pole and repelled by the north pole of the field magnet.

C

When a universal motor is run on direct current, the magnetic poles in the armature change while those of the field magnet remain constant.

D

When the commutator comes back into contact with the brushes, current flows through the armature in the opposite direction. Its poles are reversed and the turn continues.

LANGUAGE STUDY *Describing function*

Try to answer this question:

What does an electric motor do?

When we answer a question like this, we describe the function of something.

We can describe the function of an electric motor in this way:

An electric motor converts electrical energy to mechanical energy.

We can emphasize the function like this:

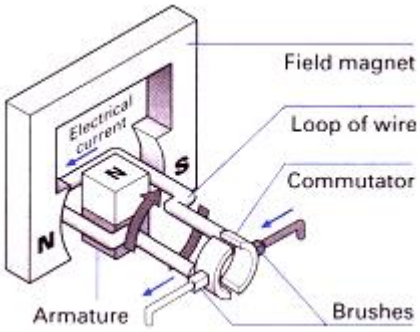
The function of an electric motor is to convert electrical energy to mechanical energy.

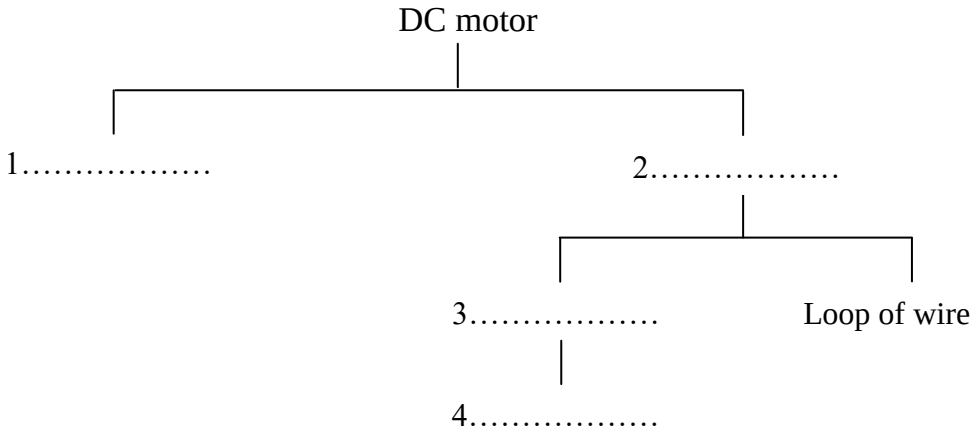
Task 4. Match each of these motor components to it function, and then describe its function in a sentence.

Component	Function
1. armature	a. transfers rotation from the motor
2. bearings	b. create an electromagnetic field
3. brushes	c. converts electromagnetic energy to rotation
4. commutator	d. reverses the current to the armature
5. drive shaft	e. support the drive shaft
6. field windings	f. supply current to the armature

WRITING *Describing components*

Task 5. Dismantle this simple dc motor into its components by completing the labeling of the chart below





Now study this description of the motor.

A simple dc motor *consists of* a field magnet and an armature. The armature *is placed between* the poles of the magnet. The armature is *made up of* a loop of wire and a split ring *known as* a commutator. The loop *is connected to* the commutator. Current is supplied to the motor through carbon blocks *called* brushes.

To write a description, you need to use language to:

1 dismantle a piece of equipment into its main parts. These expressions will help:

A	*consists of*	X and Y
	is made up of	X
	is composed of	Y

2 name components:

Carbon blocks	*known as*	brushed
	called	

3 locate components:

The armature *is placed between* the poles

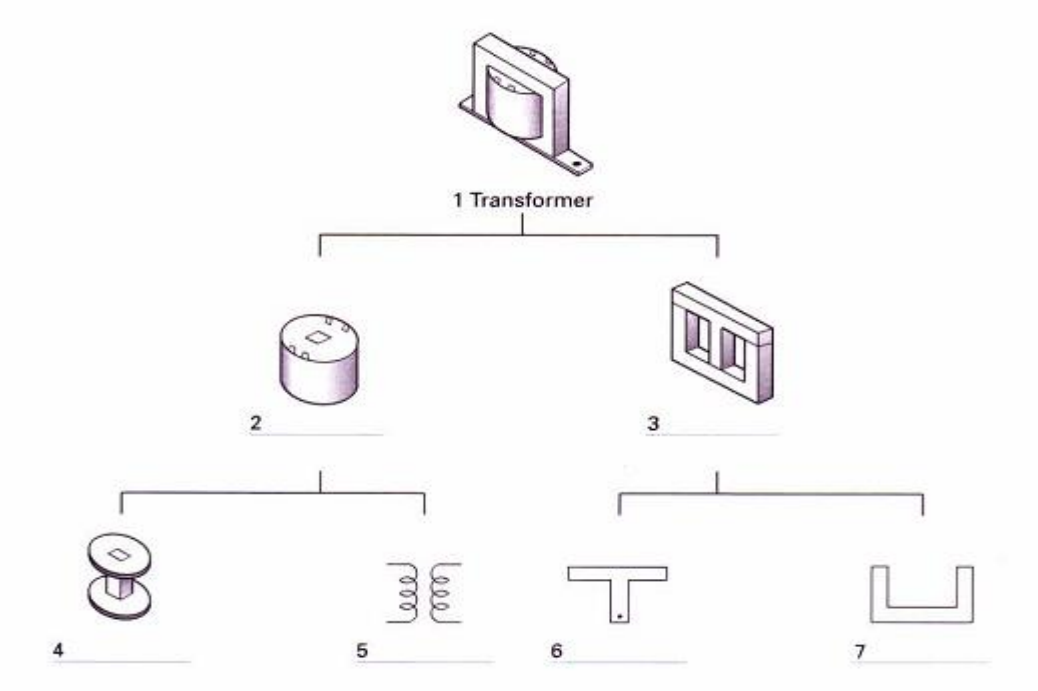
4 connect components:

The loop *is connected to* the commutator.

Task 6. Complete the text with the help of the diagram . Use the following words:
are made up *is placed* *is composed* *consists*

A transformer (1)…… of two coils, a primary and a secondary. The coils are wound on a former which is mounted on a core. The coils (2)…… of a number of loops of wire. The core (3)…… of thin pieces of soft iron. U- and T-shaped pieces are used. The former (4)…… on the leg of the T.

Now label the diagram using the completed text



WORD STUDY

Study these expressions for describing how components are connected to each other.

A is bolted to B. = A is connected to B with bolts.
A is welded to B. = A is connected to B by welding.
A is fixed to B. = no specific method given.

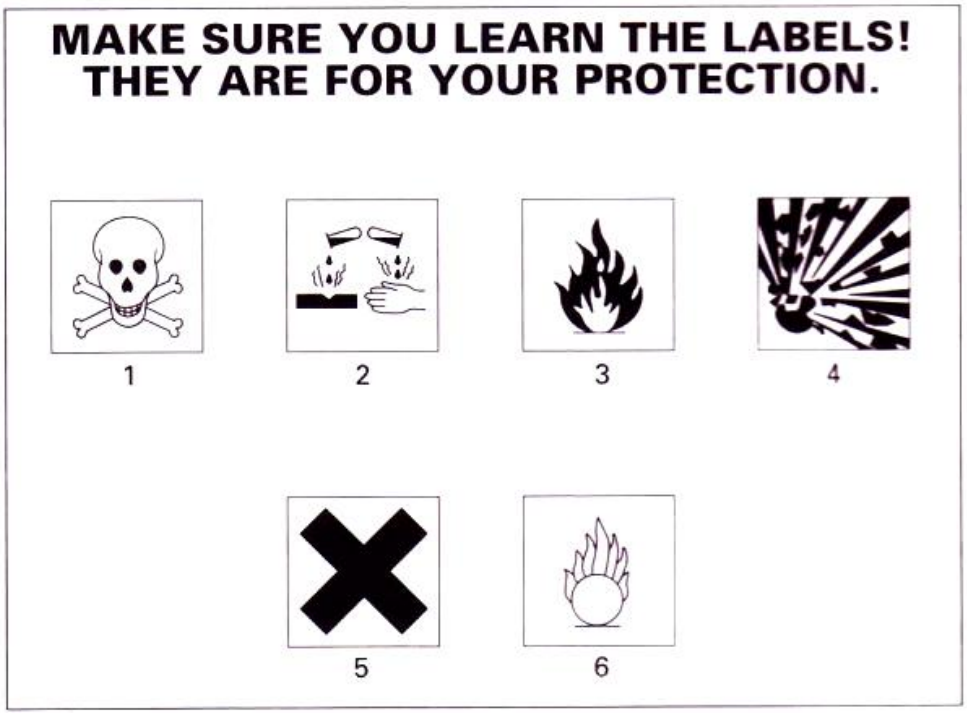
Task 7. Explain each of these methods of connection.

1. screwed ……
2. soldered ……
3. attached ……
4. wired ……
5. bonded ……
6. glued ……
7. riveted ……
8. welded ……
9. brazed ……
10. nailed ……

UNIT 4. SAFETY AT WORK

Task 1. What do these warning labels on chemicals mean? Match each label to the correct warning.

a. Highly flammable
b. Harmful
c. Explosive
d. Corrosive
e. Oxidizing
f. Toxic



Task 2. List some of the potential dangers in your laboratory, workshop, or place of work. How is the risk of these hazards reduced?

Task 3. Study the safety instructions from a workshop below, and then answer these questions.

a. Who are the instructions for?

b. Who wrote them?

c. What was the writer's purpose?

1. Wear protective clothing all times
2. Always wear eye protection when operating lathes, cutters, and grinders and ensure the guard is in place.
3. Keep your workplace tidy.
4. The areas between benches and around machines must be kept clear.
5. Tools should be put away when not in use and any breakages and losses reported.
6. Machines should be cleaned after use.

READING *Understanding the writer's purpose*

Knowing what the writer's purpose is, who the writer is, and who the intended readers are can help us to understand a text. The safety instructions in Task 3 are clearly intended to encourage employees to be safety conscious and reduce the risk of accidents. The writer is perhaps a supervisor or the company safety officer, and the intended readers are machine operatives. Knowing these things can help us to work out the meaning of any part of the text we may not understand.

Task 4. Study the company document on safety , and then answer these questions.

1. Who is this document for?

a. machine operatives

b. managers

c. all employees

d. injured employees

2. Who wrote this document?

a. trade union representative

b. technician

c. manager

d. medical staff

3. What is the writer's intention?

a. to prevent accidents

b. to ensure speedy help for injured employees

c. to protect the company

d. to warn about dangers

Accident investigation

Whenever an accident occurs that results in an injury (medical case), damage of equipment and material, or both, prompt accident investigation by the immediate manager is required. A written preliminary investigation will be completed by the end of the particular shift or business day on which the accident occurred.

In no event should there be a delay of more than 24 hours. Failure to comply with this requirement may subject the immediate manager to disciplinary action up to and including discharge.

Without adequate accident investigation data the Company may be subjected to costs, claims, and legal action for which it has no defence.

As a minimum, the preliminary accident investigation report will include the following:

1. name, occupation, and sex of injured worker.
2. Place and date/ time of accident.
3. Description of how the accident happened.
4. Immediate causes of the accident - unsafe acts and unsafe conditions.
5. Contributing causes - manager safety performance, level of worker training, inadequate job procedure , poor protective maintenance, etc.
6. Witness(es) - name and department.
7. Corrective action taken - when.

The employee who was injured and any employee(s) who witnessed the incident should be separately interviewed as soon as possible. A copy of the report must be submitted to the Manager - Human Resources for review. Another copy of the report is to be retained for a period of not less than the injured employee's length of employment plus five (5) years.

Task 5. Study this brief report of an accident. In which points does it not meet company policy on reporting accidents?

To:	**Name** Manager	**Department & Location** Human Resources	**Date** 17 May
From:	**Name** D. Taylor	**Department & Location** Mech. Eng. Workshop	**Tel.** 6200
Subject	Preliminary Report, Accident, 12 May While turning a brass component on Tuesday, last week, Kenneth Oliver, machinist, received an injury to his eye. He was taken to the Eye Hospital where I understand he was operated on. I believe the accident was due to carelessness.		

LANGUAGE STUDY *Making safety rules*

What are the differences in meaning, if any, between these statements?

1. Wear protective clothing.

2. Always wear protective clothing.

3. Protective clothing must be worn.

We can make safety rules in these ways:

1. Using an imperative.

***Wear** protective clothing.*

***Do not wear** loose-fitting clothing.*

2. ***Always/ never*** are used to emphasize that the rule holds in all cases.

***Always** wear protective clothing.*

***Never** wear loose-fitting clothing.*

3. We can use a modal verb passive for emphasis

*Protective clothing **must** be worn.*

*Protective clothing **should** be worn.*

Task 6. Study this list of unsafe environmental conditions (hazards). Write safety rules to limit these hazards using the methods given above. For example:

inadequate lighting

Lighting must be adequate. or

Lighting should be adequate.

1. uneven floors
2. unguarded machinery
3. untidy workbenches
4. untidy workplaces
5. badly maintained machinery
6. carelessly stored dangerous materials
7. inadequate ventilation
8. damaged tools and equipment
9. machinery in poor condition
10. equipment used improperly
11. equipment operated by untrained personnel
12. apprentices working without supervision

WRITING *Ways of linking ideas, 2*

In Unit 3 we learnt that to make our writing effective, we have to make sure our readers can follow our ideas. We learn how to mark reasons, results, and contrast in our writing.

What are the links between these ideas? What words can we use to mark the links?

1. The accident happened.

2. The operator's carelessness.

3. The supervisor was not present.

Sentence 2 is reason for sentence 1. Sentence 3 is an addition reason. We can mark the links between them like this:

The accident happened ***because of*** *the operator's carelessness.* ***In addition/ moreover****, The supervisor was not present.*

We use because of to introduce a reason which is a noun or noun phrase. We use in addition and moreover to introduce an additional reason.

What are the links between these ideas? What words can we to mark the links?

4. Suitable protection should be worn.

5. Safety helmets should be used where there is a danger of falling objects.

Sentence 5 is an example to illustrate sentence 4. We can mark this in this way:

Suitable protection should be worn. ***For example/ For instance****, safety helmets should be used where there is a danger of falling objects.*

Task 7. Show the links between these sets of ideas using appropriate linking words.

1. Many accidents happen.
   Workers' carelessness.
2. Education can reduce accidents.
   It is important that all workers receive training in basic safety.
3. Eye injuries can be serious.
   Goggles must be worn for grinding and cutting.
4. Safety gloves provide protection for the hands.
   They prevent burns.
   They reduce the danger of cuts.
5. Safety shoes protect the feet against falling objects.
   They prevent the feet getting caught in machinery.
6. Respirators should be worn in dusty conditions.
   Dust can damage the lungs.
7. Safety gear exists for every danger.
   Each year people are injured.
   They refuse or forget to wear the right gear.