E 1

ENGLESKI JEZIK
ZA INŽENJERE 1

ENGLESKI JEZIK ZA INŽINJERE 1

školska godina 2022/2023 fond časova 2+0
predmetni nastavnik: Ivana Mirović, kabinet 109, blok F
termin za konsultacije: petak, 12:00 email:miriv@uns.ac.rs

V semestar – stručni kurs engleskog jezika za studente na odseku: EET

Materijal za kurs obuhvata odabrana poglavlja iz udžbenika:
Oxford English for Electronics, E. Gledinning, J. McEwan, OUP, 1993
Oxford English for Electrical and Mechanical Engineering. E. Gledinning, N. Gledinning, OUP, 2008
Oxford English for Information Technology, E. Gledinning, J. McEwan OUP, 2002

PREDISPITNE OBAVEZE: **Test (30) poena**. Može se polagati samo jednom tokom semestra na času. **Ne postoji mogućnost popravljanja testa**.

Proverava se - znanje novog vokabulara (Povežite reči i objašnjenja – 6 poena)
- znanje novog vokabulara (Dopunite rečenice – 6 poena)
- znanje novog vokabulara (Navedite sinonim/ antonim – 4 poena)
- upotreba specifičnih izraza (Zaokružite tačan odgovor – 6 poena)
- upotreba veznika (Dopunite rečenice odgovarajućim veznikom – 10 poena)

ISPIT: maksimalno **70 poena**. Ispit je pismeni i usmeni.

Pismeni ispit nosi 20 poena.
I zadatak: Dopunite tekst odgovarajućim recima
Dat je jedan pasus nepoznatog teksta iz koga je izvadjeno 8 reci. Reči su date odvojeno, u odgovarajućem obliku (to mogu biti imenice, glagoli, pridevi, prilozi, veznici itd.). Koristeći znanje stečeno obradom sličnih tekstova na času, kao i poznavanje vokabulara, konstrukcije engleske rečenice i sl. treba dopuniti tekst.
II zadatak: Stavite glagol iz zgrade u odgovarajući glagolski oblik (8 poena)
Ovaj zadatak se zasniva najvećim delom na vežbama iz *Language study* i obuhvata: pasivne rečenice, relativne rečenice *(reduced relative clauses: active and passive)*, vremenske rečenice *(reduced time clauses: active and passive*), glagole: *allow, let, prevent, cause, make* i sl.
III zadatak: Koji pojmovi su opisani ovim definicijama? (4 poena)
Na osnovu opisa nekog stručnog pojma ili reči treba se setiti o kojoj se reči radi.

- **Usmeni deo ispita** 50 poena
Student izvlači ispitno pitanje (naslov jednog od obrađenih tekstova iz skripte, tekstovi koji dolaze na usmeni su navedeni jačim slovima u planu rada), i odgovara na pitanja koja postavlja nastavnik.

FORMIRANJE KONAČNE OCENE: prema skali koja je prihvaćena na Fakultetu.
(51 – 100 poena)

PLAN RADA ZA ENGLESKI JEZIK ZA INŽENJERE 1 2022/2023

14. 10. – uvodni cas

21. 10. - Understanding electronic diagrams
- Language study: *compose, consist, connect, link*

28.10. Battery charger
- Language study: describing components and functions

04. 11. - Computer Applications
- Language study: Passive
- Language study: Time clauses
- Reduced time clauses

11. 11. – neradni dan

18. 11. - Music Centre
- Language study: Allowing and preventing verbs
- **The electric motor**

https://www.youtube.com/watch?v=WV2gul2SQNc&ab_channel=its.engg.things

25. 11. Portable generator
- Language study: cause and effect

https://www.youtube.com/watch?v=Pu7g3ulG6Zo&ab_channel=YashVerma

02.12. - Wave power
https://www.youtube.com/watch?v=gcStpg3i5V8&ab_channel=IdeasfortheGreenPlanet
- veznici (ponavljanje I sitematizacija)

09. 12. - Audio recording systems
- Language study: cause and effect

16. 12. – Cathode ray oscilloscope
- Language study: cause and effect

23. 12. - Transmission lines
- reduced relative clauses

https://www.youtube.com/watch?v=De0aeropM2k&ab_channel=EasyTechnology
fiber optic:
https://www.youtube.com/watch?v=N_kA8EpCUQo&ab_channel=CorningIncorporated

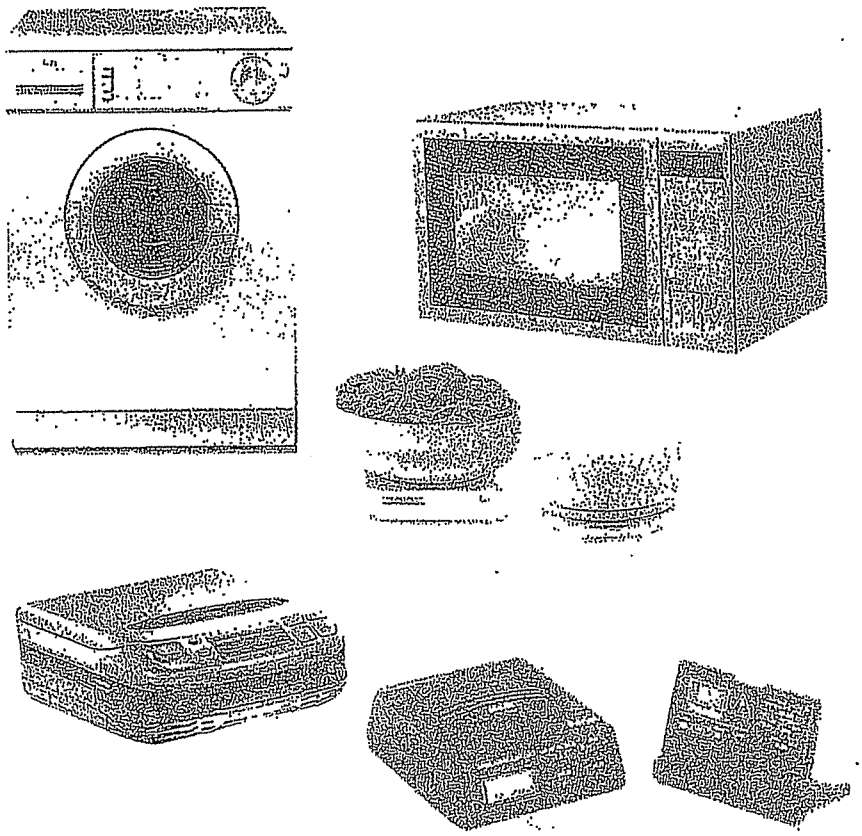
30. 12. - TEST – obavezna predispitna obaveza 30% ocene

04. 01. - Telecommunications

05. 01. – Cell phones

13. 01. - ponavljanje, priprema za pismeni

1 Electronics in the home



Tuning-in

Task 1

Make a list of things in your house which use electronics. Compare your list with that of another group.

Task 2

Find out the meaning of these abbreviations. You can use Appendix 1 on page 188 to help you.

1 IC 2 CD 3 hi-fi

Reading *Reading for a purpose*

In your study and work, it is important to have a clear purpose when you read. At the start of most units in this book, you will find tasks to give you that purpose.

Task 3

Read quickly through the text on the next page. Tick [✓] any items mentioned in the list you made in Task 1.

Electronics in the home

Electronics began at the start of the twentieth century with the invention of the vacuum tube. The first devices for everyday use were radios, followed by televisions, record players, and tape recorders. These devices were large and used a lot of power.

The invention of the transistor in 1947 meant that much smaller, low-powered devices could be developed. A wide variety of electronic devices such as hi-fi units and portable radios became common in the home.

It was not until 1958 that microelectronics began with the development of ICs (integrated circuits) on silicon chips. This led to a great increase in the use of electronics in everyday items. The introduction of the microprocessor allowed electronics to be used for the control of many common processes.

Microprocessors are now used to control many household items such as automatic washing-machines, dishwashers, central heating systems, sewing machines, and food processors. Electronic timers are found in digital alarm clocks, water heaters, electric cookers, and microwave ovens. Telephones use electronics to provide automatic dialling and answerphone facilities. New entertainment devices have been developed, such as video recorders and CD (compact disc) players.

In the future, electronics are likely to become even more common in the home as multimedia entertainment systems and computer-controlled robots are developed.

Task 4 Fill in the gaps in this table with the help of the text.

Date	Invention	Applications in the home
early 20th century	_____	_____
_____	transistor	_____
1958	_____	automatic washing-machines,
future	—	_____

Task 5 Use the space below to make a list of ways in which you think electronics may be used in the home in the future.

Reading *Understanding diagrams*

In electronics, you have to read not only texts, but also diagrams. You have to be able to combine information from both diagram and text. This text introduces two kinds of diagrams often used in electronics.

Task 6

Read the text below to find the answers to these questions:

1 What do we call the two types of diagrams shown in the text?
2 What do we call the approach to electronics which focuses on the function of units?

Understanding electronic diagrams

Although electronic devices may look complicated, they are made up of common basic units ('building blocks') connected together. The function of each of these units and the path of the signals between them can be shown in a block diagram. For example, the block diagram of a simple radio is shown in Fig. 1.

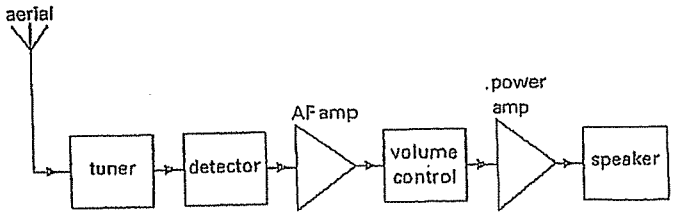


Fig. 1

To understand how the radio works, it is more important to understand the function of each unit than to know what components are used. This is known as a systems approach to electronics. For example, in Fig. 1 the tuner selects the required signal, the detector then separates off the audio part of the signal, and the AF amplifier (amp) amplifies it.

The connections and values of the components inside these basic units can be shown in a circuit diagram using standard electronic symbols. Fig. 2 shows the circuit diagram for the simple radio.

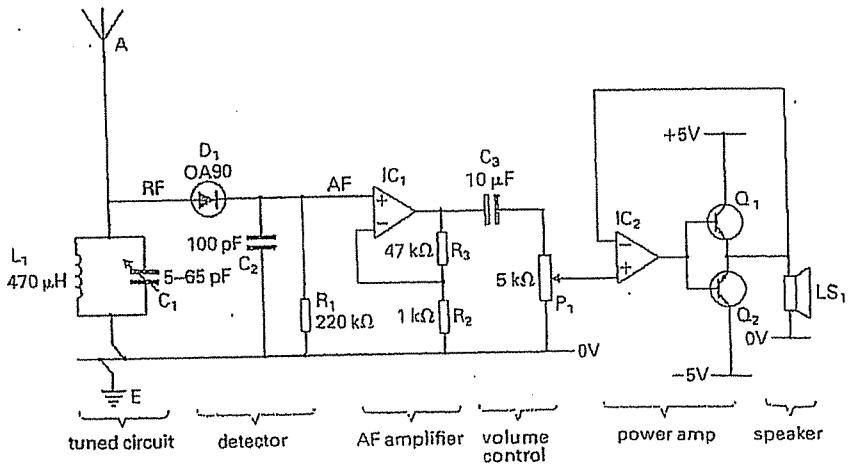


Fig. 2

Task 7 How many of the circuit symbols in Fig. 2 can you identify? Use Appendix 2 on page 206 to help you.

Language study *Describing block diagrams and circuits*

Look again at Fig. 1 above. We can describe it like this:

The radio | ***consists of*** / ***is composed of*** | *a tuner, a detector, and an AF amplifier.*

Using *comprise*, we can start our description with the blocks:

A tuner, a detector, and an AF amplifier | ***comprise*** | *the radio.*

We can describe the links between each building block using these expressions:

The tuner | ***is connected to*** / ***is linked to*** | *the detector.*

Look again at Fig. 2. We can describe the values of the components like this:

R1 *a two-hundred-and-twenty-kilohm resistor*
C2 *a hundred-picofarad (puff) capacitor*

Task 8 Describe the value of these components:

1 R2
2 C1
3 R3
4 C3
5 P1
6 L1

This table provides the terms you need:

Prefix	Symbol	Multiple	Example
giga	G	10^9	GHz gigahertz
mega	M	10^6	MΩ megohms
kilo	k	10^3	kV kilovolts
deci	d	10^{-1}	dB decibels
milli	m	10^{-3}	mW milliwatts
micro	μ	10^{-6}	μH microhenries
nano	n	10^{-9}	nF nanofarads
pico	p	10^{-12}	pF picofarads

Looking now at the basic units of the circuit, we can describe the volume control like this:

> The volume control consists of a ten-microfarad electrolytic capacitor connected in series with a five-kilohm potentiometer (pot). The positive terminal of the capacitor is connected to the output of the AF amplifier and the wiper of the pot is connected to the power amp. The third terminal of the pot is connected to the zero voltage supply rail, which is earthed.

Task 9

Fill in the gaps in this description of the tuned circuit shown in Fig. 2. Each gap represents one word.

The circuit [1]_____ of a four hundred and seventy [2]_____ inductor which is connected in parallel with a [3]_____ capacitor. The [4]_____ can be varied between five and sixty-five [5]_____. The aerial is [6]_____ to the top end of the tuner. It is also connected to the positive terminal of the [7]_____ in the detector. The bottom end of the tuner is connected to earth via the zero voltage [8]_____ rail.

Speaking practice

Task 10

Work in pairs, A and B. Complete your circuit diagram with help from your partner.

Ask questions like these:

What kind of component is P1?
What's the value of C1?
What is connected between the collector of Q2 and the positive side of the battery?

If you don't understand your partner, say:

I'm sorry, I don't understand. Could you say that again, please?
Could you speak more slowly?

If your partner doesn't understand you at first, try phrasing your answer in a different way. For example:

It's a variable resistor. It's a resistor which you can vary or change by turning the control. It's called a variable resistor.

Student A: Your circuit diagram is on page 174.
Student B: Your circuit diagram is on page 181.

Writing *Describing diagrams*

Task 11

With the help of the diagram, fill in the gaps in the description on page 12. Each gap represents one word. The description should answer these questions:

1 What is the diagram of?
2 What does it consist of in terms of blocks?
3 How are the blocks connected?
4 What is the function of each block?

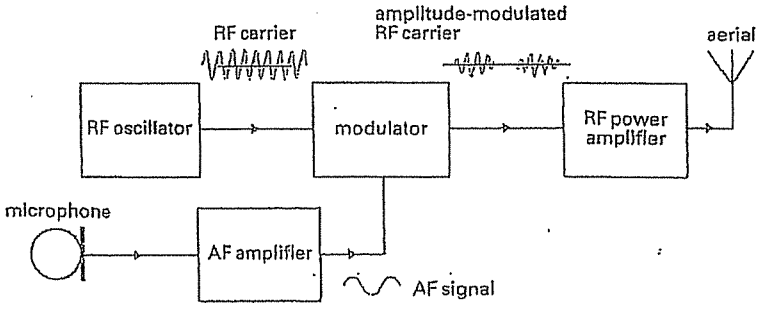


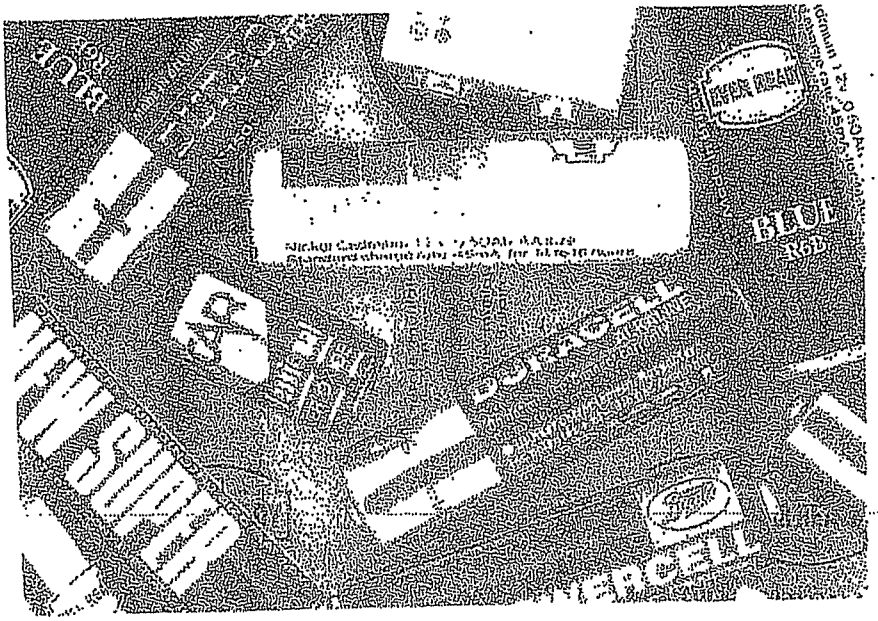
Fig. 3

Fig. 3 shows the block diagram of an amplitude-modulated (AM) radio transmitter. It [1]_____ of a radio frequency (RF) oscillator, a [2]_____, an audio frequency (AF) amplifier, and an RF power amplifier. The RF [3]_____ generates an RF [4]_____ wave which is fed into the modulator.

The microphone converts sounds into audio frequency signals which are amplified by the AF [5]_____. The modulator then uses the amplified AF [6]_____ to modulate the RF carrier wave.

The power of the modulated carrier wave is increased by the RF [7]_____ amplifier. The strong modulated output signals are fed to the [8]_____ which enables them to be transmitted over long distances.

5 Batteries



Tuning-in

Task 1

Study this statement:

Twenty billion batteries are sold every year.

Why do you think this is so? What different kinds of batteries are there? List some of the things you use which contain batteries. Compare your list with someone else's.

Task 2

Try to complete this table of the differences between two kinds of cells. Use these terms:

secondary, manganese dioxide, cadmium, primary, nickel, zinc, portable phones, torches

	Zinc-carbon cell	NiCad cell
Type of cell	P	S
Positive electrode	Mang. dio.	N
Negative electrode	Z	Cad
Example of use		

Task 3

Now listen to the tape to check your answers.

Task 4 Now read this text. Note any further information about these cells.

	Zinc-carbon cell	NiCad cell
Electrolyte	ammo. chloride	
EMF	1.5 V	1.2 V

Zinc-carbon cell

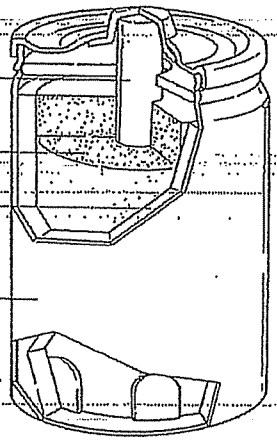
It has a zinc negative electrode, a manganese dioxide positive electrode, and the electrolyte is a solution of ammonium chloride. The carbon rod is in contact with the positive electrode (but is not involved in the chemical reaction) and is called the current collector. The EMF is 1.5V and the internal resistance about 0.5Ω. This is the most popular cell for low-current or occasional use, e.g. in torches.

Nickel-cadmium cell (NiCad)

The electrodes are of nickel (+) and cadmium (–) and the electrolyte is potassium hydroxide. It has an EMF of 1.2V and is made in the same sizes as primary cells, e.g. HP2, PP3; button types are also available. High currents can be supplied. Recharging must be by a constant current power supply because of the very low internal resistance.

Task 5 Label this diagram of a Zinc-carbon cell with these terms. More than one term can refer to the same part of the diagram.

a zinc can
b current collector
c jacket
d carbon rod
e positive electrode
f electrolyte



Language study · *Describing components*

Two questions we may need to answer when we describe components are:

1 What is it called?
2 What does it do?

In other words, we need to be able to:

1 label components.
2 describe their function.

We can use these ways of labelling components:

It is called a Zinc-carbon cell.
It is known as a NiCad cell.

We can describe the function of components like this:

*A cell **provides** electricity.*
*Cells **change** chemical energy into electricity.*

Task 6

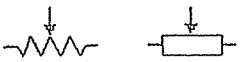
Here are some circuit symbols. Label them and describe their function. For example:

5 h *It's called a transformer. It steps AC voltages up or down.*

This list of functions may help you.

a varies capacitance in a circuit
b rectifies alternating current
c adds resistance to a circuit
d measures very small currents
e breaks a circuit
f protects a circuit
g varies the current in a circuit
h steps AC voltages up or down
i receives RF signals
j measures voltages

1 

2 

3 

4 

5

6 

7 

8 

9 

10 

Speaking practice

Task 7

Work in pairs, A and B. You have some details, but not all, about two kinds of cells. Find out the missing details from your neighbour so that you can complete your table.

Student A: Your table is on page 174.
Student B: Your table is on page 181.

Word study *Verbs and related nouns*

Task 8

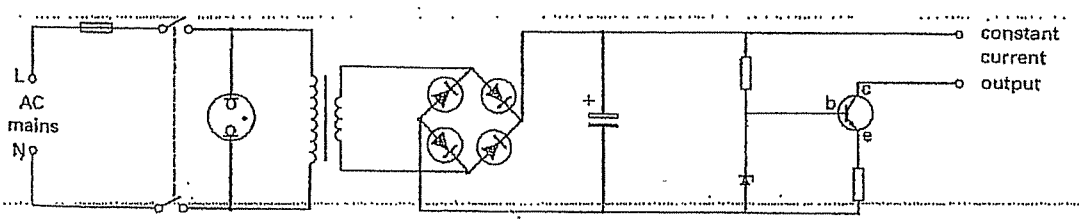
Each of these verbs has a related noun ending in *-er* or *-or* which refers to an instrument or component. Complete the column of nouns. You have met these nouns in this and earlier units.

	Verb	Noun
Example	*record*	*recorder*
1	oscillate	_____
2	transmit	_____
3	transform	_____
4	charge	_____
5	rectify	_____
6	process	_____
7	amplify	_____
8	collect	_____
9	detect	_____
10	tune	_____

Technical reading *Battery charger*

Task 9

Study this circuit diagram of a battery charger and try to name all the components.



Now read this text to check your answers:

The power to drive an electronic circuit is normally provided by an AC mains power supply but batteries are often used for portable equipment. Secondary cells can be recharged to their original voltage and can therefore be used many times over.

Recharging is done using a battery charger which consists of a mains power supply with a DC output slightly larger than the required battery EMF. A current is driven through the battery in the opposite direction to its normal output current. The block diagram of a battery charger is shown in Fig. 1.

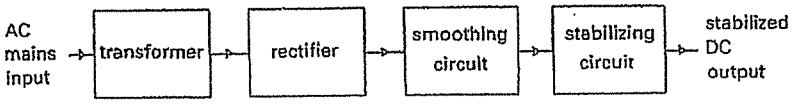


Fig. 1

The first stage consists of a transformer which steps down the voltage of the AC mains (see Fig. 2).

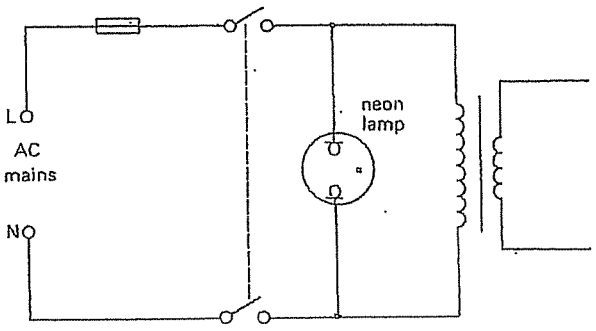


Fig. 2

The charger is switched on and off by a double-pole switch connected in series with the mains input. A neon lamp, connected across the primary of the transformer, shows when the charger is on. A fuse is connected in the live side of the supply to protect the transformer.

The second stage is a bridge rectifier which converts the AC voltage to a DC voltage (see Fig. 3).

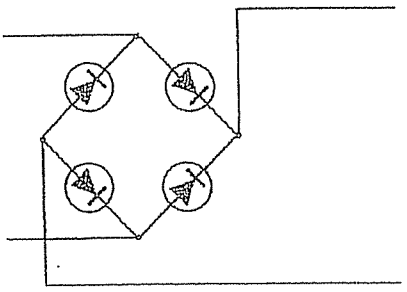


Fig. 3

This can be made from discrete components but more usually consists of four diodes contained in one package. It is mounted on an aluminium heatsink to keep the diodes from overheating.

The third stage is a smoothing circuit. It removes the fluctuations in the DC output of the rectifier. It consists of a large electrolytic capacitor connected in parallel with the rectifier as shown in Fig. 4.

Fig. 4

The final stage is a stabilizing circuit consisting of a transistor biased by two resistors and a zener diode. This prevents the output from changing when the load varies. NiCad batteries have such a small internal resistance that the charger must produce a constant current output (see Fig. 5).

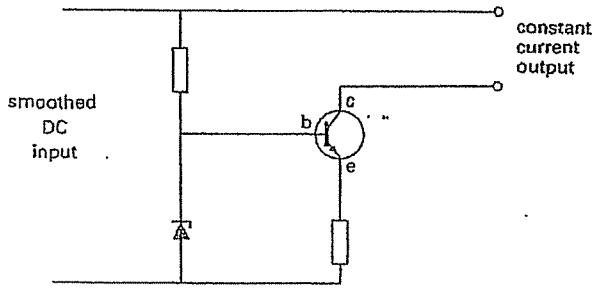


Fig. 5

Task 10 Match each component or unit with its function in a battery charger. For example:

The transformer steps down the AC mains voltage.

	Component/Unit		Function in a battery charger
1	transformer	a	steps down the AC mains voltage
2	double-pole switch	b	prevents the output from changing when the load varies
3	neon lamp	c	keeps the diodes from overheating
4	fuse	d	shows when the charger is on
5	rectifier	e	removes the fluctuations in the DC output of the rectifier
6.	aluminium heatsink	f	protects the transformer
7	smoothing circuit	g	converts the AC voltage to a DC voltage
8	stabilizing circuit	h	switches the charger on and off

UNIT 3

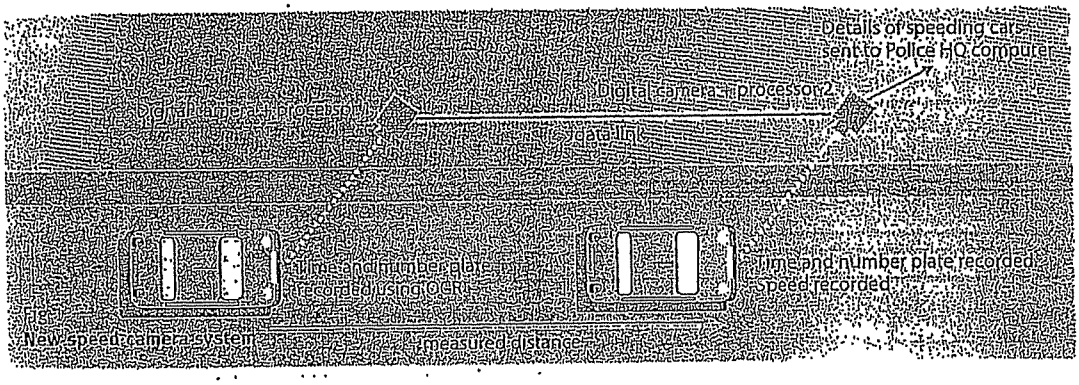
Computer Applications

STARTER **1** Work in groups. List as many uses as you can for computers in one of these areas.

1 supermarkets
2 hospitals
3 airports
4 police headquarters

READING **2** Study this diagram. Using only the diagram, try to list each stage in the operation of this computerised speed trap to make an explanation of how it operates. For example:

1 Camera 1 records the time each vehicle passes.



3 Part 1 of the text describes the system which predates the one shown in Fig 1. Does it contain any information that may help complete your explanation? Read it quickly to find out. Ignore any information which is not helpful to you.

In the last ten years, police have installed speed trap units on many busy roads. These contain a radar set, a microprocessor and a camera equipped with a flash. The radar sends out a beam of radio waves at a frequency of 24 gigahertz. This is equivalent to a wavelength of 1.25 cms. If a car is moving towards the radar, the reflected signal will bounce back with a slightly smaller wavelength. If away from the radar, the waves will reflect with a slightly longer wavelength. The microprocessor within the unit measures the difference in wavelength between outgoing and returning signals and calculates the speed of each vehicle. If it is above the speed pre-set by the police, the camera takes a picture of the vehicle. The information is stored on a smart card for transfer to the police computer. The owner of the vehicle can then be traced using the Driver and Vehicle Licensing Centre database.

4 Part 2 describes the new system. Read it to complete the stages in your explanation.

Some drivers have now got used to these traps. They slow down when they approach one to ensure that the camera is not triggered. They speed up again as soon as they have passed. This is known as 'surfing'. One way of outwitting such motorists is a new computerised system. This consists of two units equipped with digital cameras positioned at a measured distance apart. The first unit records the time each vehicle passes it and identifies each vehicle by its number plates using optical character recognition software. This information is relayed to the second unit which repeats the exercise. The microprocessor within the second unit then calculates the time taken by each vehicle to travel between the units. The registration numbers of those vehicles exceeding the speed limit are relayed to police headquarters where a computer matches each vehicle with the DVLC database. Using mailmerge a standard letter is then printed off addressed to the vehicle owner.

Structure Work: Present passive

Study these sentences.

1 The radar sends out a beam of radio waves.
2 The information is stored on a smart card.

In 1 the verb is active and in 2 it is passive in the Present passive. Why is this so? What difference does it make? In 1 the agent responsible for the action is included – the radar. In 2 the agent is not included although we know what it is – the microprocessor. The passive is often used to describe the steps in a process where the action is more important than the agent and where the agent is already known to the reader. If we need to add the agent we can do so like this:

3 The information is stored on a smart card *by the microprocessor*.

5 Describe the operation of the new speed trap by converting each of these statements to the Present passive. Add information on the agent where you think it is necessary.

1 The first unit records the time each vehicle passes.
2 It identifies each vehicle by its number plates using OCR software.
3 It relays the information to the second unit.
4 The second unit also records the time each vehicle passes.
5 The microprocessor calculates the time taken to travel between the units.
6 It relays the registration numbers of speeding vehicles to police headquarters.
7 A computer matches each vehicle with the DVLC database.
8 It prints off a letter to the vehicle owners using mailmerge.

6 With the help of this diagram, sequence these steps in the operation of an EPOS till. Then write a description of its operation in the Present passive.

a The scanner converts the barcode into electrical pulses.
b The branch computer sends the price and description of the product to the EPOS till.
c The scanner reads the barcode.
d The branch computer records the sale of the product.
e The till shows the item and price.
f The checkout operator scans the item.
g The scanner sends the pulses to the branch computer.
h The till prints the item and price on the paper receipt.
i The branch computer searches the stock file for a product matching the barcode EAN.

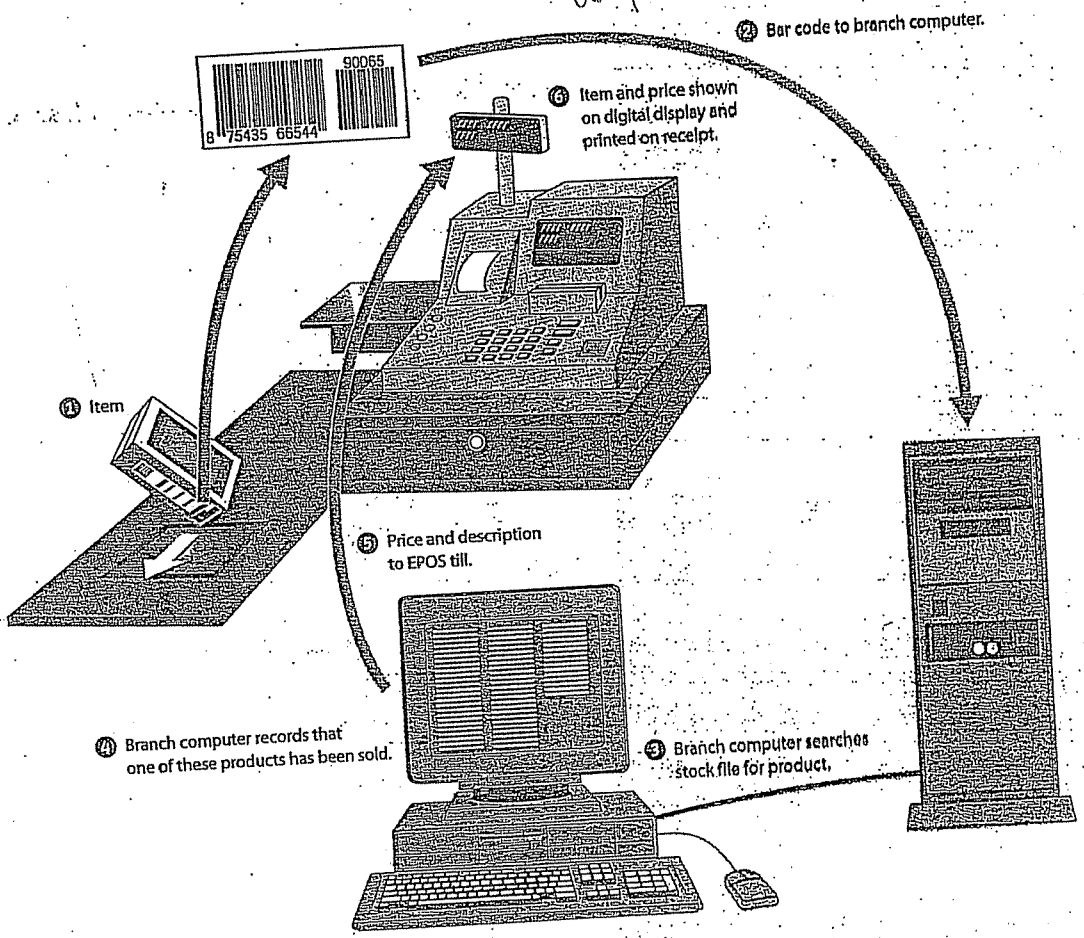


Fig 2
Operation of EPOS till

Language study *Reduced time clauses*

Study these two actions:

1 *Ground waves pass over sand.*
2 *Ground waves lose energy.*

We can link these actions to make one sentence, using a time clause:

***When** ground waves pass over sand, they lose energy.*

Because the subject of both actions is the same – *ground waves* – there is a shorter method we can use to link the actions:

***When passing** over sand, ground waves lose energy.*

When** + **-ing shows that Action 2 happens during the same period as Action 1.

Now study these two actions:

1 *The sky wave strikes the earth.*
2 *The sky wave bounces back again.*

Again we can link these actions to make one sentence, using a time clause:

***When** the sky wave strikes the earth, it bounces back again.*

We can also link the actions in a shorter way:

***On striking** the earth, the sky wave bounces back again.*

On** + **-ing shows that Action 2 follows immediately after Action 1.

Task 5 Link these pairs of actions. Use short ways when this is possible.

1 a The switch is closed.
b Current flows through the primary of the transformer.

2 a The radar signal strikes a plane.
b The radar signal is reflected.

3 a A cell discharges quickly.
b A cell may become hot.

4 a The TV receives signals from the remote control.
b The TV follows your instructions.

5 a The radar receiver receives the reflected signal.
b The signal is compared with the transmitted signal.

6 a You choose a course in electronics.
b You think carefully about your future.

7 a Microwave signals strike a high building.
b Microwave signals are deflected.

8 a You make a recording.
b You should ensure the recording levels are satisfactory.

9 a The alarm detects an intruder.
b The alarm triggers an audible warning.

10 a The remote control button is pressed.
b The television set changes channel.

4 🎧 Now listen to this recording which explains how the process works and take brief notes on each stage. For example:

Stage 1
Click on a webpage hyperlink or URL.
The browser sends the URL to a DNS server.

LANGUAGE WORK Time clauses

What is the relationship between each of these pairs of actions?

1 a You click on a URL.
b Your browser sends it to a DNS server.
2 a The packets are passed from router to router.
b They reach the Web server.
3 a The packets may travel by different routes.
b They reach the Web server.
4 a The individual packets reach the Web server.
b They are put back together again.

Each pair of actions is linked in time. We can show how actions are linked in time by using time clauses. For example:

We can use *when* to show that one action happens immediately after another action:

1 *When* you click on a URL, your browser sends it to a DNS server.

We can use *once* in place of *when* to emphasise the completion of the first action. It often occurs with the Present perfect. For example:

Once the DNS server has found the IP address, it sends the address back to the browser.

We can use *until* to link an action and the limit of that action:

2 The packets are passed from router to router *until* they reach the Web server.

We can use *before* to show that one action precedes another:

3 The packets may travel by different routes *before* they reach the Web server.

If the subjects are the same in both actions, we can use a participle:

The packets may travel by different routes *before* reaching the Web server.

We can use *as* to link two connected actions happening at the same time:

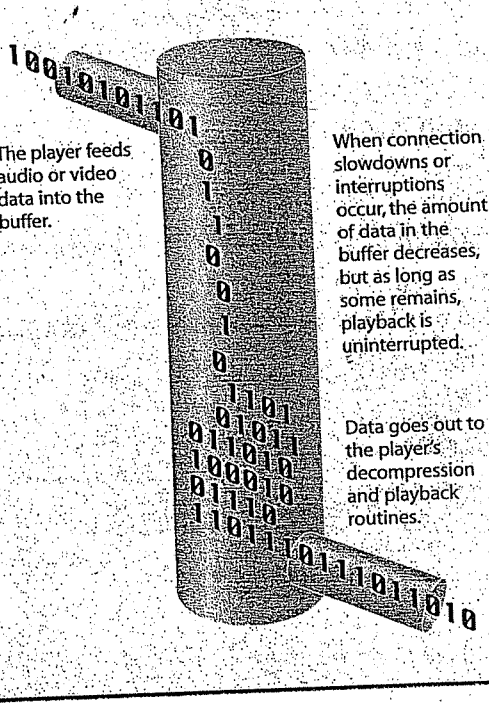
4 As the individual packets reach the Web server, they are put back together again.

5 Link each pair of actions using a time clause.

1 a You use a search engine.
b It provides a set of links related to your search.
2 a With POP3, email is stored on the server.
b You check your email account.
3 a You have clicked on a hyperlink.
b You have to wait for the webpage to be copied to your computer.

4 a You listen to the first part of a streamed audio file.
b The next part is downloading.
5 a The graphics can be displayed gradually.
b The webpage is downloaded.
6 a You receive an email message.
b You can forward it to another address.
7 a You click on a hyperlink.
b The browser checks to see if the linked webpage is stored in the cache.
8 a You can bookmark a webpage to make it easier to find in the future.
b You find a webpage you like.
9 a You type in a Web address.
b You should press the Enter key.
10 a You click on the Home button.
b The browser displays your starting webpage.

6 Fill in the gaps in this description of buffering, a way of ensuring that Web video runs smoothly.



Streaming is a way of dealing with bandwidth problems .....[1] you download video from the Internet. One key to successful streaming is the process of buffering. .....[2] you download a movie, the video player stores part of the movie in memory .....[3] playing it. Imagine the buffer as a container filled from the top as shown in Fig 3. .....[4] the container is full, the player sends data on for playback from the bottom. Data keeps coming in .....[5] a clip plays. The user can view the beginning of the movie .....[6] the rest of the clip downloads. .....[7] connection slowdowns or interruptions occur, the amount of data in the buffer decreases but as long as some remains, playback is uninterrupted. Playback continues at a steady rate .....[8] the buffer is empty.

Fig 3
Video buffering

13 Music centre

Tuning-in

Task 1 Study this picture of a music centre.

1 What forms of audio input does it have?
2 What other forms of audio input might be added?

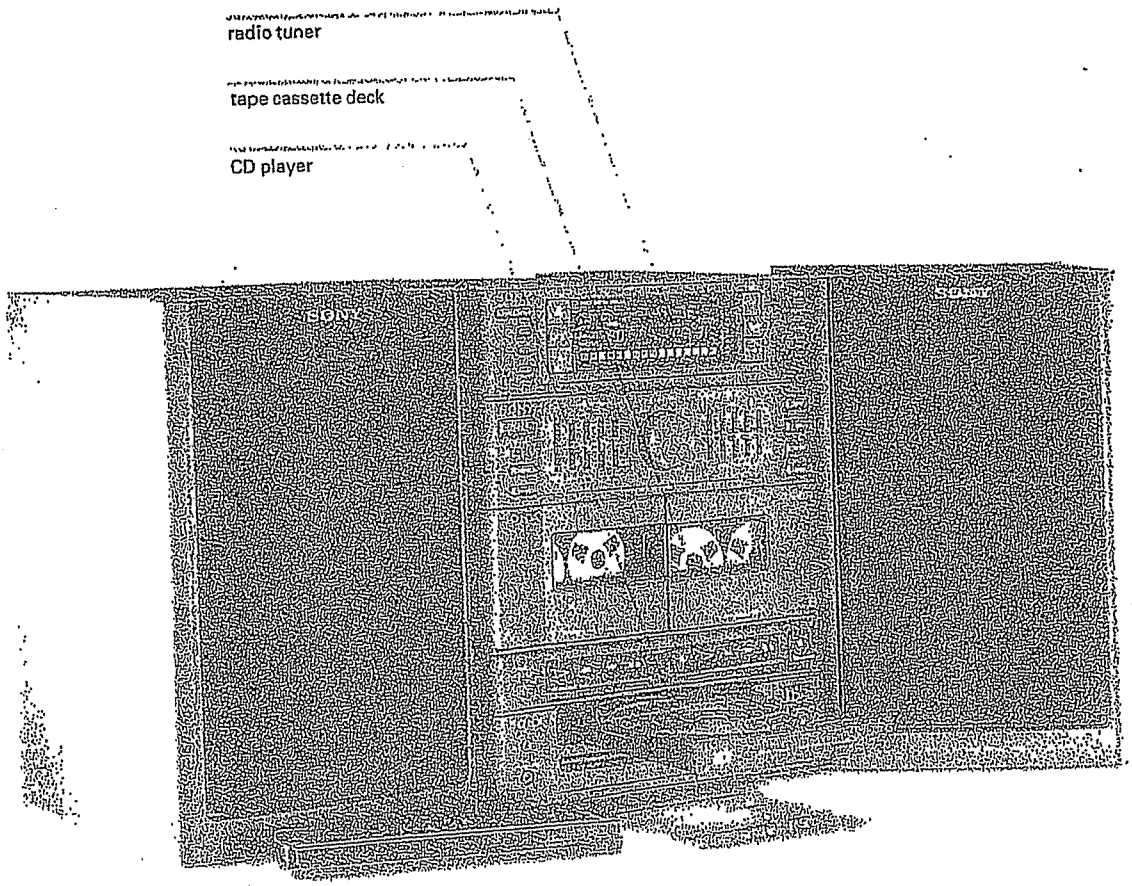


Fig. 1

Task 2 Read this text to check your answer to question 1 of Task 1.

Fig. 1 shows a music centre. It contains a number of audio input devices: a CD player, a radio tuner, and a tape cassette deck. These allow the user to play music recorded in different formats. All these devices share a common amplifier and speaker system. Each part of the music centre is stacked one on top of the other.

Task 3 Read the rest of the text to find out:

1 the function of a pre-amplifier
2 the function of a power amplifier
3 the function of a graphic equalizer
4 the difference between a hi-fi and a midi-fi system

As Fig. 2 shows, the common amplifier is made up of two sections. The first section is the pre-amplifier (pre-amp), which provides tone, volume, and balance controls as well as amplification of the input signal voltages. The second section is the power amplifier (power amp). This amplifies the power of the pre-amp signals to enable them to drive the loudspeaker system.

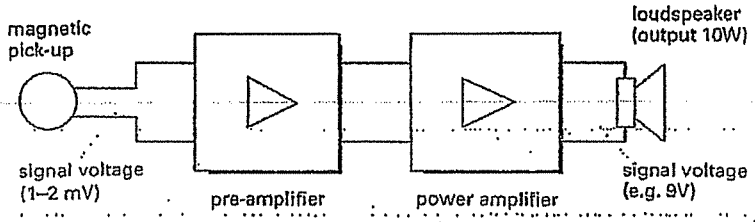


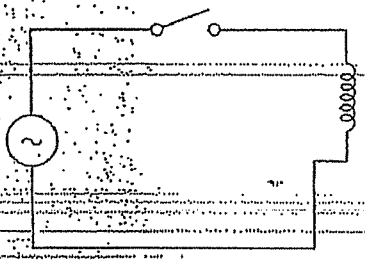
Fig. 2

Some music centres also contain a graphic equalizer. This allows the user to adjust the amplification of particular frequency ranges by moving an array of slider controls. In this way the reproduced sound can be varied to suit different acoustic conditions.

A music centre can be classified as a hi-fi (high-fidelity) system or a mid-fi system depending on the quality of its sound reproduction.

Language study *Allowing and preventing verbs*

What happens as a result of . . .
closing the switch?
opening the switch?



Closing the switch:
We can describe the result using these verbs:

Closing the switch	***allows*** / ***permits*** / ***enables***	*current **to** flow through the coil.*

Note that verbs like *allow* are followed by *to* and the infinitive.

Opening the switch:
We can describe the result using these verbs:

Opening the switch	***prevents*** / ***stops***	*current **from** flow**ing** through the coil.*

Note that verbs like *prevent* are followed by *from* and the *-ing* form.

Task 4 Now fill in the gap in each sentence with an allowing or preventing verb. Also put each verb in brackets in the correct form.

1 A graphic equalizer ..... the user (adjust) the amplification of different frequency ranges.

2 A fuse ..... a sudden rise in current (damage) equipment.

3 A mixing desk ..... the sound engineer (improve) the quality of the sound recorded.

4 A heatsink ..... output transistors (overheat).

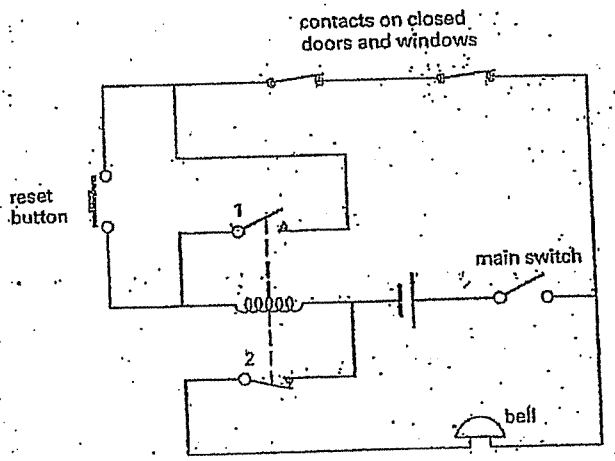
5 A surge suppressor ..... large current fluctuations (damage) computers.

6 Special effects like reverb ..... the engineer (alter) the sound of the recording.

7 Different inputs on the music centre ..... the user (play) CDs, cassettes, and MDs.

8 A safety tab ..... the user (erase) the tape by accident.

Task 5 Study this circuit of a burglar alarm. It contains a relay. The relay is shown in its unenergized form.



Now fill in the gaps in this description with appropriate verbs like *allow* or *prevent*, and put each verb in brackets in the correct form. Compare your answers with your partner.

Closing the main switch [1] ..... current (pass) from the battery through the bell. As a result the bell rings. Pressing the reset button [2] ..... current (flow) through the relay coil. This energizes the coil so that switch 1 closes and switch 2 opens. Opening switch 2 [3] ..... current (flow) through the bell.

rect
you th

Task 6

Language study *Allow and prevent links*

Fig. 4 shows the most basic components of a pneumatic system, a three-port valve (3PV) and a single acting cylinder (SAC). The steps below describe the operation of the system when the push button of the valve is pressed. The first step is a. Put the others in the correct sequence.

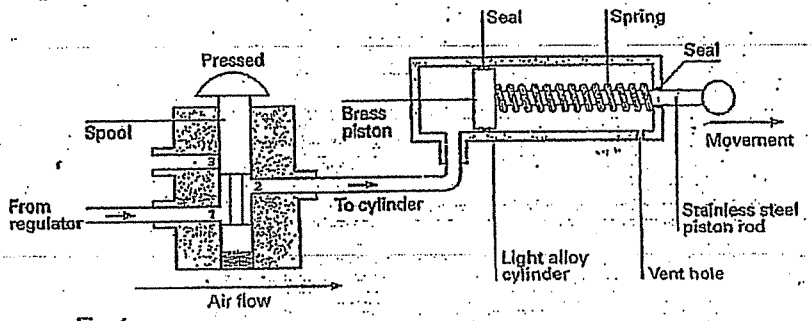


Fig. 4

a The push button is pressed. 1
b Port 3 is blocked. ____
c Ports 1 and 2 are connected. ____
d The piston compresses the spring. ____
e The spool is pushed down. ____
f Air cannot escape. ____
g Compressed air flows through the valve to the SAC. ____
h The compressed air pushes the piston along. ____

Study these steps from the operation of the valve.

3 Ports 1 and 2 are connected.
4 Compressed air flows through the valve to the SAC.
5 Port 3 is blocked.
6 Air cannot escape.

What is the connection between Step 3 and Step 4?
What is the connection between Step 5 and Step 6?

Step 3 *allows* Step 4 to happen. We can link the steps in three ways like this:

a *Ports 1 and 2 are connected. This **allows** compressed air to flow through the valve to the SAC.*
b *Ports 1 and 2 are connected. This **permits** compressed air to flow through the valve to the SAC.*
c *Ports 1 and 2 are connected. This **lets** compressed air flow through the valve to the SAC.*

Step 5 *prevents* something. We can link steps 5 and 6 like this:

*Port 3 is blocked. This **prevents** air **from** escaping.*

6 The electric motor

Tuning-in

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 3 you studied scanning – locating specific information quickly. Another useful strategy is reading a text quickly to get a general idea 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 _____

para 1

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.

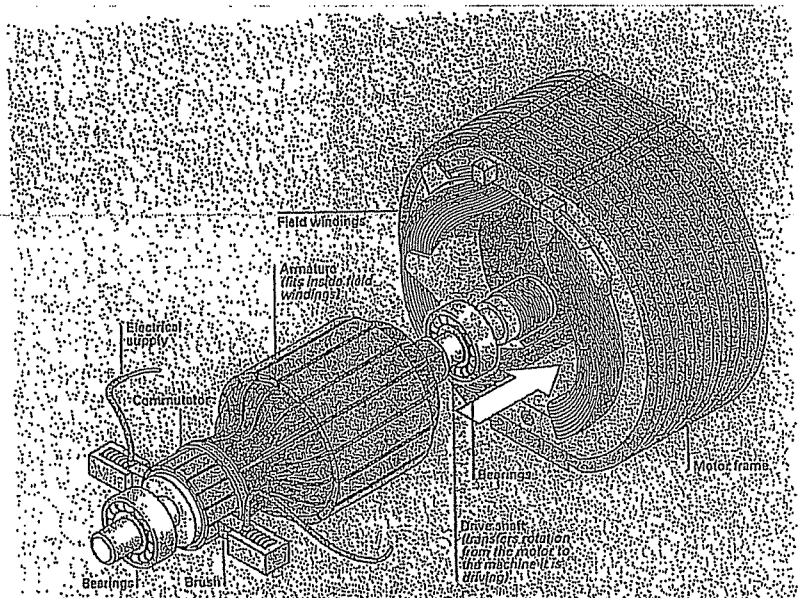


Fig. 1

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

15 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.

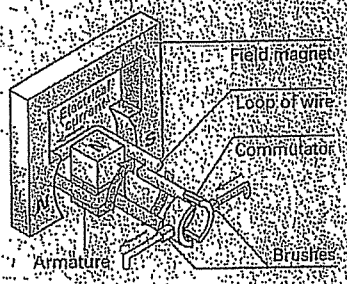


Fig. 2

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. Once 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.

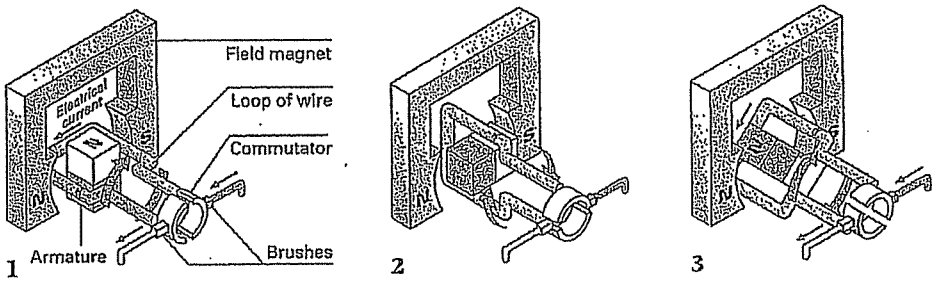
To reverse the direction of the current, the ends of the armature wire are connected to different halves of a split ring called a commutator. Current flows to and from the commutator through small carbon blocks called brushes. As the armature turns, first one half of the commutator comes into contact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

Source: Adapted from 'Inside our 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.)

Motor run on direct current



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.

17 Portable generator

Tuning-in

Task 1 List the different ways in which electricity can be generated.

Reading *Reading diagrams*

Task 2 Study the diagram below of a portable generator. Answer these questions using the diagram and your own knowledge of engineering.

1 What are its main parts?
2 What does the engine run on?
3 What are the four strokes called?
4 What is the function of the crankshaft?
5 What do both stator and rotor have?
6 What is the difference between stator and rotor?

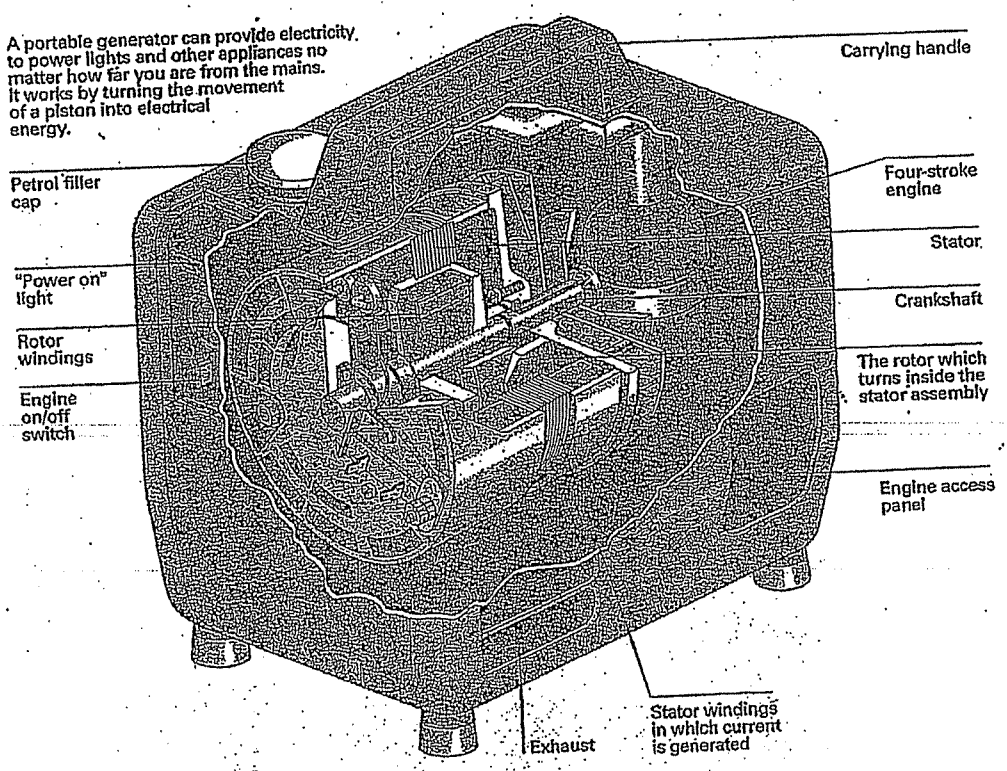


Fig. 1

Task 3

Read this text to check as many of the answers as you can. You will not find complete answers to all of the questions.

Portable generator

Although most electricity comes from power stations, power can also be generated by far smaller means. Nowadays, electricity generators can be small enough to hold in the hand.

Portable generators are made up of two main parts: an engine, which powers the equipment, and an alternator, which converts motion into electricity.

The engine shown (Fig. 1) runs on petrol. It is started by pulling a cord. This creates a spark inside which ignites the fuel mixture.

In a typical four-stroke engine, when the piston descends, the air inlet valve opens and a mixture of air and petrol is sucked in through a carburettor.

The valve closes, the piston rises on the compression stroke and a spark within the upper chamber ignites the mixture. This mini-explosion pushes the piston back down, and as it rises again the fumes formed by the ignition are forced out through the exhaust valve.

This cycle is repeated many times per second. The moving piston makes the crankshaft rotate at great speed.

The crankshaft extends directly to an alternator, which consists of two main sets of windings – coils of insulated copper wire wound closely around an iron core. One set, called stator windings, is in a fixed position and shaped like a broad ring. The other set, the armature windings, is wound on the rotor which is fixed to the rotating crankshaft. The rotor makes about 3,000 revolutions per minute.

The rotor is magnetized and as it spins round, electricity is generated in the stator windings through the process of electromagnetic induction. The electric current is fed to the output terminals or sockets.

This type of generator can produce a 700 watt output, enough to operate lights, television, and some domestic appliances. Larger versions provide emergency power to hospitals and factories.

Source: Adapted from 'Inside out: Portable generator', *Education Guardian*

Task 4

Study this text on the four-stroke cycle. Then label each stroke correctly in Fig. 2 opposite.

In the four-stroke cycle, the piston descends on the intake stroke, during which the inlet valve is open. The piston ascends on the compression stroke with both valves closed and ignition takes place at the top of the stroke. The power or expansion stroke follows. The gas generated by the burning fuel expands rapidly, driving the piston down, both valves remaining closed. The cycle is completed by the exhaust stroke, as the piston ascends once more, forcing the products of combustion out through the exhaust valve. The cycle then repeats itself.

Technical reading *Wave power*

Task 9

The two texts which follow describe two plants for generating electricity from wave power. Note the similarities and differences between the plants.

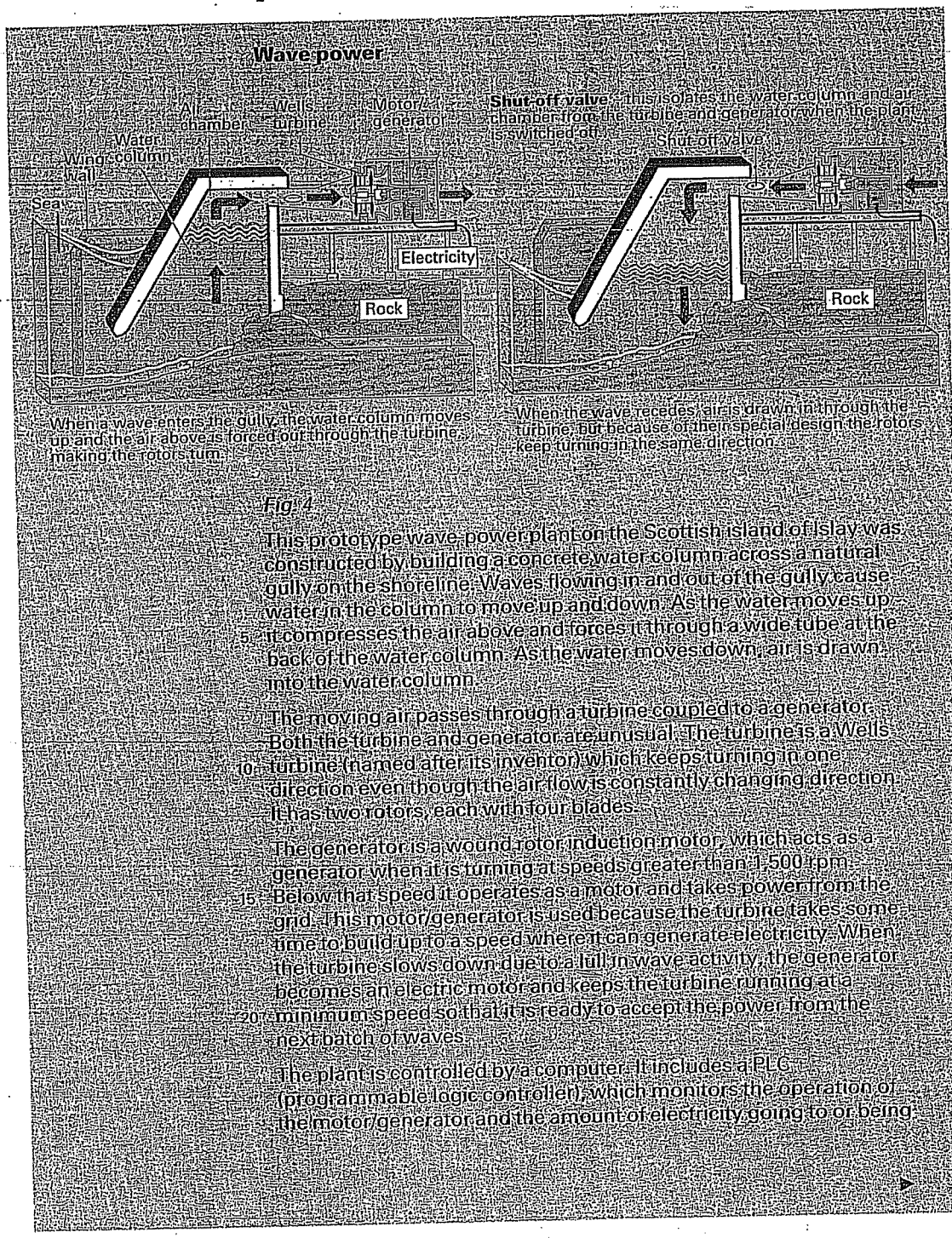


Fig. 4

This prototype wave-power plant on the Scottish island of Islay was constructed by building a concrete water column across a natural gully on the shoreline. Waves flowing in and out of the gully cause water in the column to move up and down. As the water moves up it compresses the air above and forces it through a wide tube at the back of the water column. As the water moves down, air is drawn into the water column.

The moving air passes through a turbine coupled to a generator. Both the turbine and generator are unusual. The turbine is a Wells turbine (named after its inventor) which keeps turning in one direction even though the air flow is constantly changing direction. It has two rotors, each with four blades.

The generator is a wound rotor induction motor, which acts as a generator when it is turning at speeds greater than 1,500 rpm. Below that speed it operates as a motor and takes power from the grid. This motor/generator is used because the turbine takes some time to build up to a speed where it can generate electricity. When the turbine slows down due to a lull in wave activity, the generator becomes an electric motor and keeps the turbine running at a minimum speed so that it is ready to accept the power from the next batch of waves.

The plant is controlled by a computer. It includes a PLC (programmable logic controller) which monitors the operation of the motor/generator and the amount of electricity going to or being

taken from the grid. There is also testing equipment to monitor how much electricity the plant is producing and the efficiency of the water column, turbine, and generator.

This experimental plant generates 150 kW. Plans have been approved for the construction of a 1 MW scheme.

Source: Adapted from 'Inside out: Wave power', *Education Guardian*

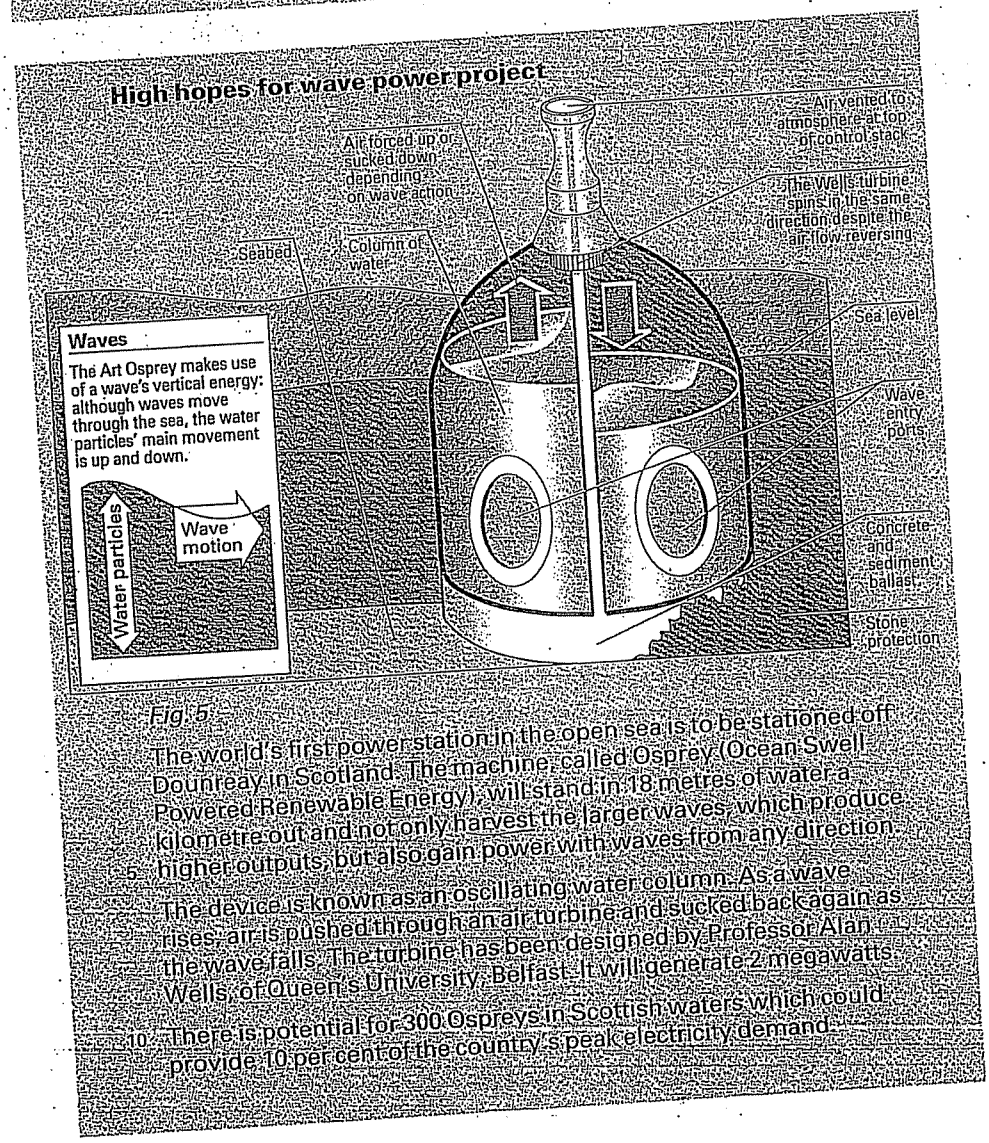


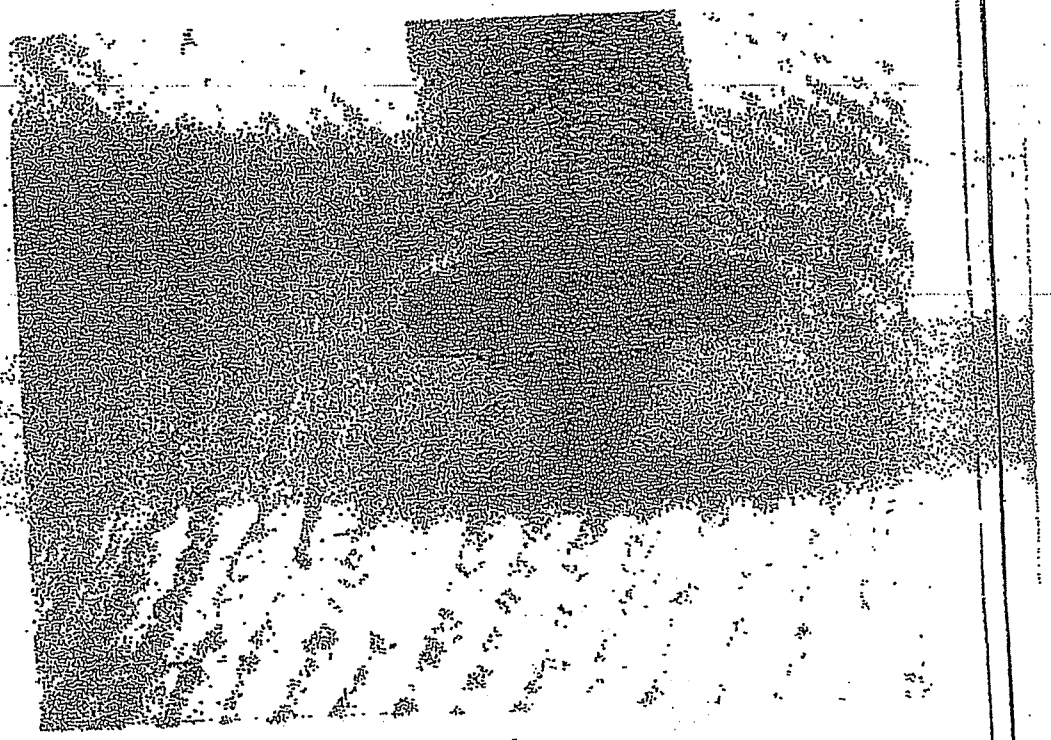
Fig. 5

The world's first power station in the open sea is to be stationed off Dounreay in Scotland. The machine, called Osprey (Ocean Swell Powered Renewable Energy), will stand in 18 metres of water a kilometre out and not only harvest the larger waves, which produce higher outputs, but also gain power with waves from any direction.

The device is known as an oscillating water column. As a wave rises, air is pushed through an air turbine and sucked back again as the wave falls. The turbine has been designed by Professor Alan Wells, of Queen's University, Belfast. It will generate 2 megawatts.

There is potential for 300 Ospreys in Scottish waters which could provide 10 per cent of the country's peak electricity demand.

16 Audio recording systems



Tuning-in

Task 1 Try to answer these questions:

1. What problems are there with records?
2. What other recording systems are there?
3. What do these abbreviations mean?
   a LP
   b CD

Task 2 Read quickly through this text to check your answers to Task 1.

Audio recording systems

For a long time hi-fi recordings have been produced on vinyl gramophone records. Records use an analogue recording system, which stores patterns by cutting a continuous groove in a vinyl disk. The shape of the sides of the groove represents the audio pattern. The sound can be reproduced by spinning the record and using the movement of a metal needle in the groove to produce varying magnetic fields (see Fig. 1). These magnetic fields are then processed to produce the sound. A typical LP (long-playing record) has a recording capacity of about 45 minutes.

The stylus vibrates in the groove and recreates the recorded sound.

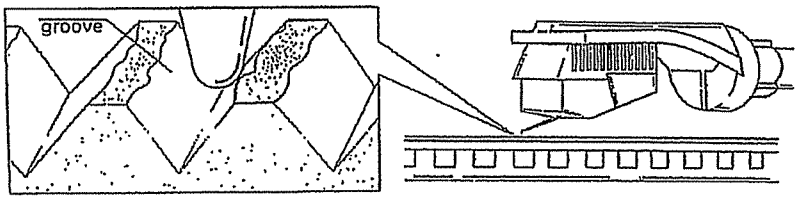


Fig. 1

A digital recording system, known as a compact disc (CD) system, was introduced in 1982. This uses a laser optical mechanism in which a laser beam reads marks on the surface of a specially prepared perspex disc. It gives near-perfect reproduction of sound and the sound quality does not deteriorate with use. Some of the problems associated with vinyl records are eliminated such as 'crackle' caused by dust and static, and 'jumping', due to scratches on the recording surface.

In a CD system, a recording is made by electronically sampling the sound 44,100 times every second. The electronic samples are used to control a laser beam, which makes a pattern of very small pits in the surface of the perspex disc. The audio pattern is represented by the length of the pits and the distance between them. The pits are arranged in circular tracks. A typical CD has about 20,000 circular tracks and a maximum recording capacity of 74 minutes.

To play back the recording, the disc is made to revolve at a constant speed and a laser beam is directed at its surface. The varying reflection of the laser beam is fed into a digital-to-analogue converter (DAC). This produces the electronic signals, which are amplified to drive a loudspeaker.

Task 3 Use the text above to complete this table of differences between LPs and CDs:

		LPs	CDs
1	Recording system	analogue	_____
2	Sound quality	poorer than the original	_____
3	Access	serial	random
4	Audio pattern	_____	pits
5	Material	_____	perspex
6	Playing mechanism	mechanical	_____
7	Durability	easily damaged	_____
8	Size	12 inches	12cm
9	Playing time	_____	_____

Language study *Cause and effect, 1*

Study this sentence:

Dust on records causes crackle.

It contains a cause and an effect. Identify them.

We can link a cause and effect as follows:

Cause		Effect
Dust on records	***causes***	*crackle.*
	leads to	
	results in	
	is the cause of	

We can also put the effect first:

Effect		Cause
Crackle	***is caused by***	*dust on records.*
	results from	
	is the effect of	
	is due to	

Task 4 Items in List 1 can be causes or effects of items in List 2. Match the pairs. Compare your answers with your partner. For example:

mains frequency interference ——— hum

List 1		List 2
1 distortion		a interference on radios
2 noise generated within components		b too high a recording level
		c the tape rubbing against the head
3 overheating a transistor		d scratches on records
4 dirty heads		e hiss
5 a build-up of oxide on the head		f damage
6 jumping		g poor recordings
7 unwanted signals		

Task 5 Write sentences to show the relationship between the pairs you linked in Task 4. For example:

Mains frequency interference results in hum.

Speaking practice

Task 6 Work in pairs, A and B.

Student A: Read the text on page 177 to find out about DCCs.
Student B: Read the text on page 184 to find out about MDs.

Complete your section of the table at the top of the following page. Then find out enough information from your partner to complete the other section of the table. When you have finished, read each other's texts to check you have completed the table correctly.

Ask questions like these:

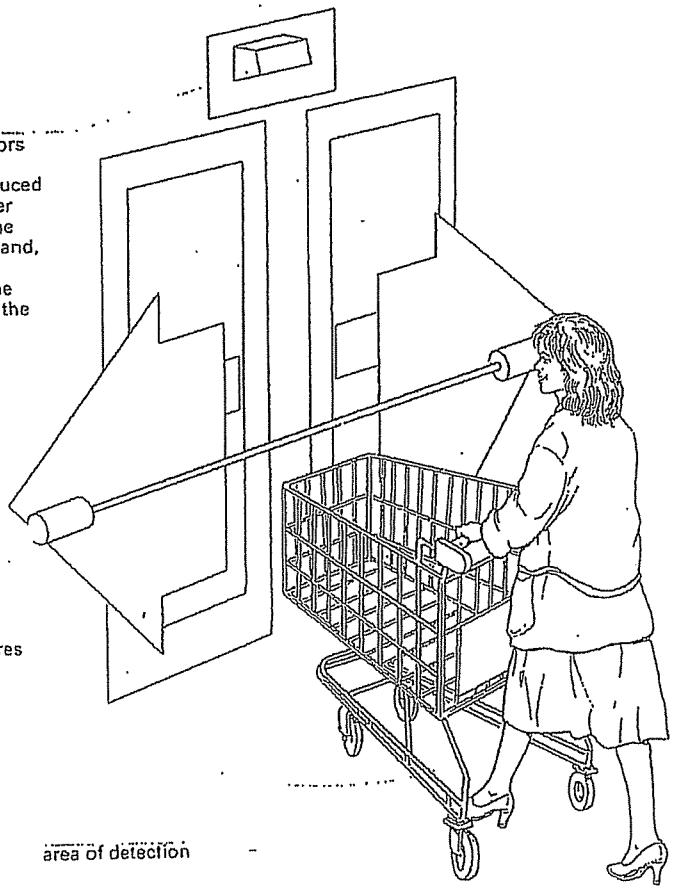
What recording system do MDs use?
What's the sound quality like?

		DCC	MD
1	Recording system		
2	Sound quality		
3	Access		
4	Medium		
5	Playing time		
6	Advantages		

Writing *Linking facts and ideas, 3*

Task 7

Study this diagram, which explains the operation of automatic doors. Then turn to the next page and link each set of statements using words or phrases of your own to make your own explanation. Omit unnecessary words and make any other changes required.



1 Automatic doors are used in places such as airports, supermarkets, and hospitals.
Traditional doors would be a nuisance in these places.

2 Automatic doors are fitted with a microwave sensor.
The sensor detects movement.

3 The doors are switched on.
A microwave transmitter sends out a microwave beam.

4 The beam is in a semicircular pattern.
The doors open when you approach from any angle.

5 The microwaves are reflected back to the sensor.
The reflected microwaves are analysed by a microprocessor.

6 A person or object moves towards the doors.
The waves are reflected back to the sensor at a different frequency.

7 The microprocessor detects this change.
The microprocessor instructs the motor to open the doors.

8 The doors are fitted with a time-delay mechanism.
The doors remain open for about four seconds before closing again.

9 A person remains standing in the doorway.
A safety beam prevents the doors from closing.

Word study *Common verbs in electronics*

Task 5

These verbs are often used in electronics:

conduct emit rectify sample
dissipate process record suppress

Fill in the gaps in these sentences with an appropriate verb from the list above. Make sure the verb is in the correct form.

1 Computers _____ data.

2 You can _____ sound on tape or disc.

3 A bridge circuit is used to _____ alternating current to produce direct current.

4 All metals, and some non-metals such as carbon, _____ electricity.

5 To prevent radio interference, you must _____ any sources of interference such as car ignition systems.

6 Power transistors _____ heat. Therefore they must be mounted on a heatsink.

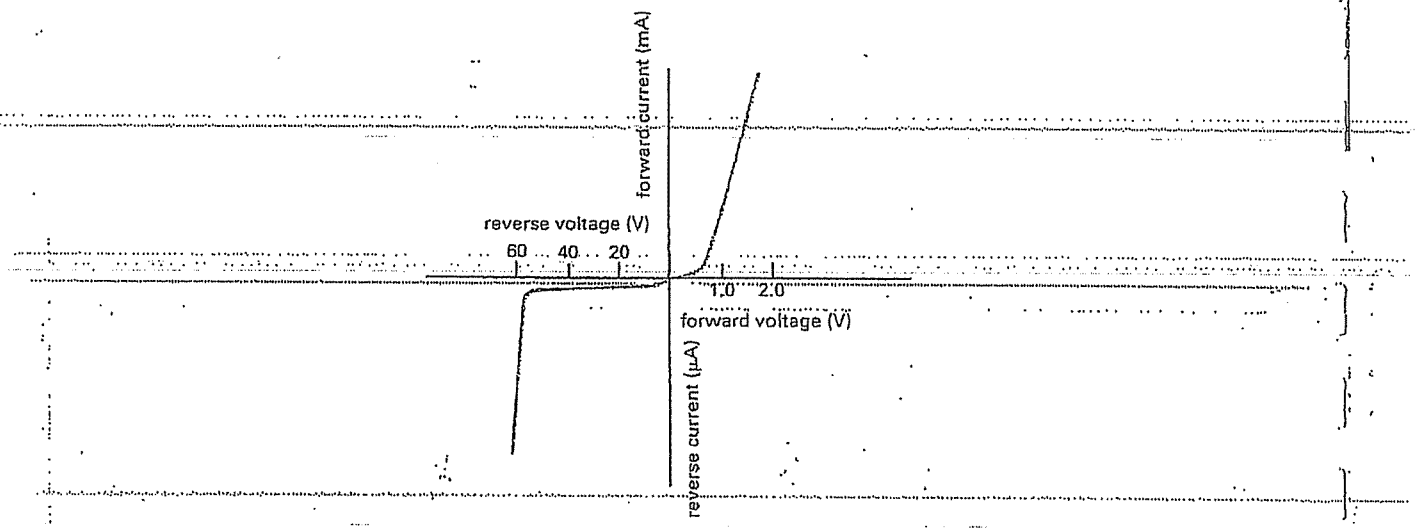
7 The electron gun in a CRT _____ a stream of electrons.

8 When recording a CD, sound is _____ 44,100 times every second.

Writing *Describing graphs*

Task 6

Study this graph which shows what happens when a voltage is applied across a silicon PN junction diode.



Now complete the spaces in this text with reference to the graph. Each space represents several missing words.

The first quadrant shows the characteristics of the diode when it is forward biased. When the voltage is increased, at first the current [1] _____. When the voltage reaches about 600mV there is [2] _____. The current continues to rise as [3] _____ but eventually a point is reached where the diode would be destroyed by heat.

The third quadrant shows what happens when the diode is reverse biased. There is almost no [4] _____. The diode is therefore a good rectifier. It conducts well in one direction and almost not at all in the other. However, there is [5] _____ reverse current. This leakage current [6] _____ until what is known as breakdown voltage. At this point there is [7] _____ in the reverse current. This sudden increase is called the Zener effect.

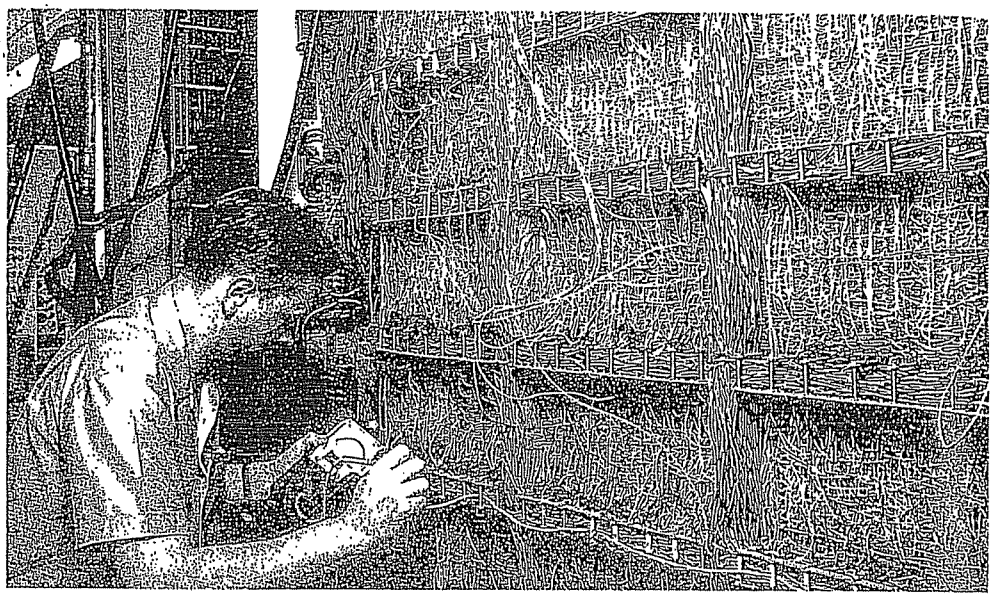
Speaking practice

Task 7

Work in pairs, A and B. Give your partner sufficient information about your graph so that he or she can sketch it. When you have finished, compare the graphs you have drawn with the originals.

Student A: Your graph is on page 178.
Student B: Your graph is on page 185.

19 Test and repair instruments

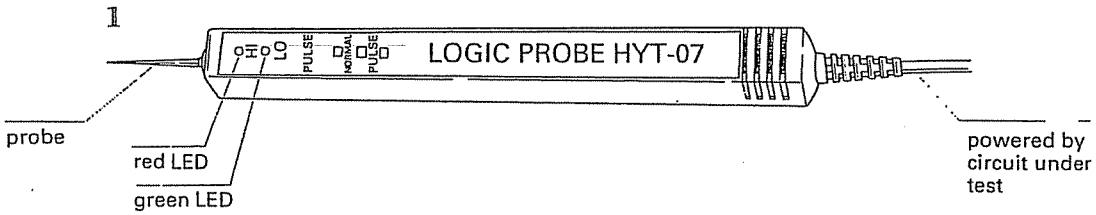


Tuning-in

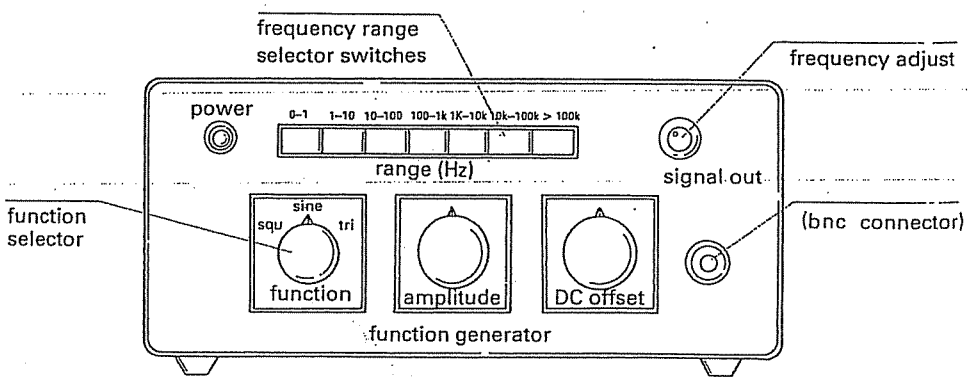
Task 1 List as many instruments used for testing and repair in electronics as you can. Compare your list with that of another group.

Task 2 How many of these instruments can you identify? Can you explain their use?

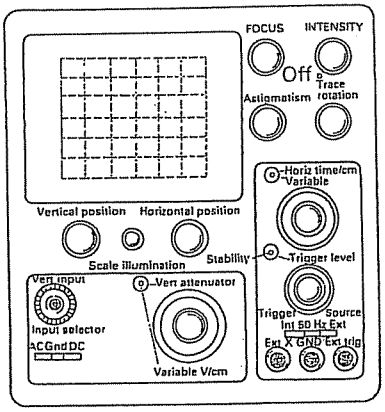
1



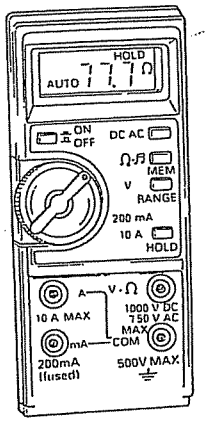
2



3



4



Task 3

Check your answers to Tasks 1 and 2 by reading this text:

The following instruments are commonly used for the test and repair of electronic circuits.

Multimeter
This instrument can be used to measure a number of different electrical quantities, such as voltage, current, and resistance, i.e. it is a combined voltmeter, ammeter, and ohmmeter. Multimeters can have analogue or digital displays and can be switched to different measuring ranges.

Logic probe
This instrument is used for measuring voltage levels and pulses in digital logic circuits. When the probe is placed on the pin of a logic IC, small coloured LEDs light up to indicate if a pulse is detected or whether the pin is at a high or a low logic level.

Oscilloscope
This instrument is used to measure fast-moving signals. It shows how a signal varies with time or relative to another signal. It uses a cathode ray tube to display the waveform of the measured signal on a screen.

Function generator
This instrument contains a triangular wave oscillator which can be switched to produce triangular, square, or sine waves over a range of frequencies. It is used to test and adjust a variety of electronic equipment such as audio amplifiers. The function generator provides a known signal which can be injected into a circuit. Often it is used with an oscilloscope so that a visual display of the waveform can be seen.

Task 4

Which of the instruments would you use to do the following?

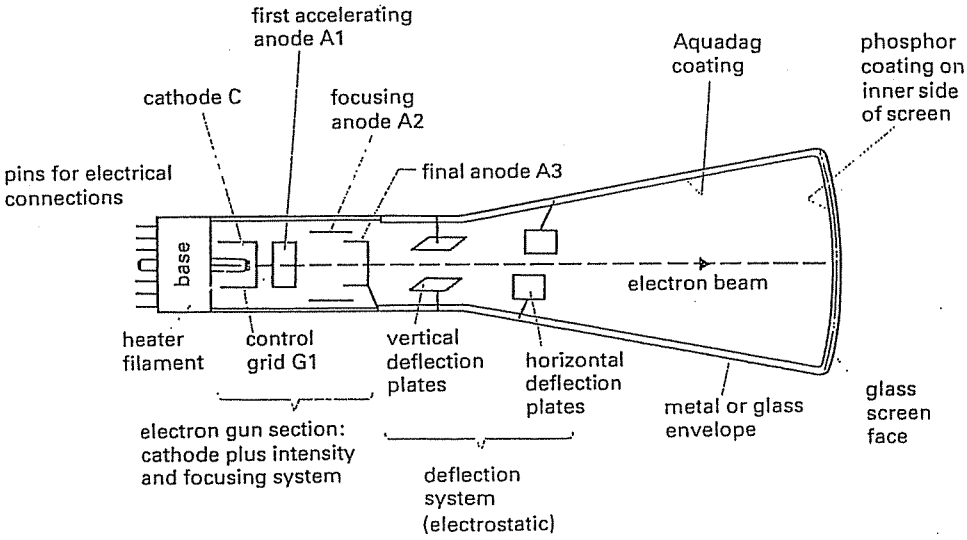
1 to check a fuse 4
2 to determine the frequency response of an audio amplifier
3 to test for the presence of a control signal on the output pin of a computer chip
4 to determine the value of the current through a transformer
5 to measure the frequency of an oscillator

Reading *Information transfer*

The task which follows provides further practice in combining information from a diagram and a text when reading.

Task 5

With the help of this diagram, complete the gaps in the text.



CRT construction

Fig. 1

Cathode ray tube

Televisions as well as computers, radar systems, and oscilloscopes use a cathode ray tube (CRT) to produce an output display. The construction and operation of the CRT is similar in each case but the simplest type of CRT is found in oscilloscopes.

A CRT is really a large vacuum tube valve. It has [1] _____ main sections. The first section is an electron [2] _____ which emits a stream of electrons. The electron gun contains an electron lens which [3] _____ the electrons into a narrow electron [4] _____.

The second section is a [5] _____ system, which allows the beam to be moved [6] _____ or horizontally. Oscilloscopes use charged metal [7] _____ to give [8] _____ deflection, whereas television sets use electromagnetic coils to give electromagnetic [9] _____.

The last section is a screen with a [10] _____ coating. The electron beam hits the screen, making the phosphor glow and causing a spot to be displayed. The colour of the spot depends on the type of phosphor used.

Language study *Cause and effect, 2*

Study these statements:

1 *The electron beam hits the screen.*
2 *The phosphor glows.*

Why does the phosphor glow? What is the relationship between statement (1) and (2)?

Statement (1) is a *cause* and statement (2) is an *effect*. We can link cause and effect statements in a number of ways. Study these ways, which use *cause* and *make*.

The electron beam hits the screen ***causing*** *the phosphor to glow.*

The electron beam hits the screen ***making*** *the phosphor glow.*

Now study these cause and effect statements:

3 *The phosphor glows.*
4 *A spot is displayed.*

The effect is in the passive. We can link cause and effect like this:

The phosphor glows ***causing*** *a spot* ***to be*** *displayed.*

Task 6

Link each of these cause and effect statements to make one sentence:

1 a A magnetic field is set up in the speaker coil.
  b The coil vibrates.

2 a The coil pushes and pulls the speaker cone.
  b Sound waves are produced.

3 a A voltage is applied to a quartz crystal.
  b The quartz crystal expands and contracts.

4 a A voltage is applied to the Y-plates.
  b The electron beam is deflected.

5 a Current flows through the filament.
  b The heater glows.

Word Study *Compound nouns, 2*

Task 7

Study these examples of compound nouns:

a signal generator = equipment for generating signals
a cassette player = equipment for playing cassettes
a battery tester = equipment for testing batteries

What do we call equipment for . . .

1 playing CDs?
2 receiving radio (signals)?
3 charging batteries?
4 amplifying aerial (signals)?
5 filtering (out) noise?
6 synthesizing speech?
7 cleaning cassette heads?
8 amplifying (the) power (of a signal)?
9 sensing vibration?
10 scanning (the human) body (for disease)?

Technical reading *Cathode ray oscilloscope*

Task 8

Work in groups of three: A, B, and C.

Student A: Read *Electron gun* and take notes.
Student B: Read *Deflection system* and take notes.
Student C: Read *Phosphor screen* and take notes.

Using your notes and Fig. 1 on page 104, explain to the others in your group how your section of the CRT works. A should start. B may use Fig. 2 as part of the explanation.

Electron gun

para

A stream of electrons is released from the surface of the cathode (C) when it is heated by the heater filament. The electrons are accelerated towards the screen by a set of three positively-charged cylindrical anodes (A1, A2, A3). Each anode has a higher charge than the one before. As the electrons move towards the anodes, they pass through a hole in a negatively-charged metal disc. This disc is known as the control grid. By adjusting the intensity control on the oscilloscope, the charge on the grid can be varied. This allows the number of electrons reaching the screen, and therefore the brilliance or brightness of the spot on the screen, to be adjusted. 1

The three anodes form the electron lens. The oscilloscope focus control allows the voltage on the second anode (A2) to be varied and causes the stream of electrons to be focused into a narrow beam. If the oscilloscope has an astigmatism control, it is used to vary the voltage on the third anode (A3). This allows the shape of the spot on the screen to be adjusted to make it perfectly round. 2

Deflection system

After leaving the electron gun, the electron beam is deflected by two pairs of parallel metal plates. The pairs of deflection plates are situated at right angles to each other. 3

The signal to be measured is amplified by the Y-amplifier in the oscilloscope, then applied to the first set of deflection plates, known as the Y-plates. This causes the electron beam to be deflected vertically in proportion to the magnitude of the input signal. 4

The oscilloscope has a timebase generator which produces a sawtooth wave output as shown in Fig. 2. 5

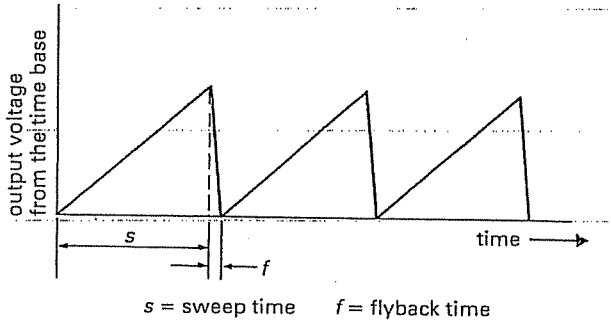


Fig. 2.

para

This is fed into the X-amplifier of the oscilloscope, then applied to the second set of deflection plates, known as the X-plates. This causes the electron beam to be deflected in the horizontal direction in such a way that the spot moves from left to right across the screen at a steady rate. When it reaches the right side of the screen, it rapidly returns to the left side again. This allows the screen to show how the measured signal varies with time. 6

Phosphor screen

The X and Y deflections of the electron beam cause the signal being measured to be displayed in the form of a wave, with the magnitude of the signal being given on the vertical axis and the time variation on the horizontal axis. A piece of transparent plastic known as a graticule is attached to the front of the screen. This has a grid of horizontal and vertical lines marked on it and allows accurate measurements of the signal to be made. 7

A large build-up of negative charge could be caused by the electron beam hitting the phosphor screen. To help prevent this, the inside of the CRT, between the deflection system and the screen, is coated with a carbon compound known as Aquadag. This is attached to the high voltage anode (A3) to provide an escape path for the excess electrons. 8

The CRT is enclosed in a metal casing made from an alloy of nickel, known as mu-metal. This has a very high magnetic permeability and prevents external magnetic fields from causing unwanted beam deflections. 9

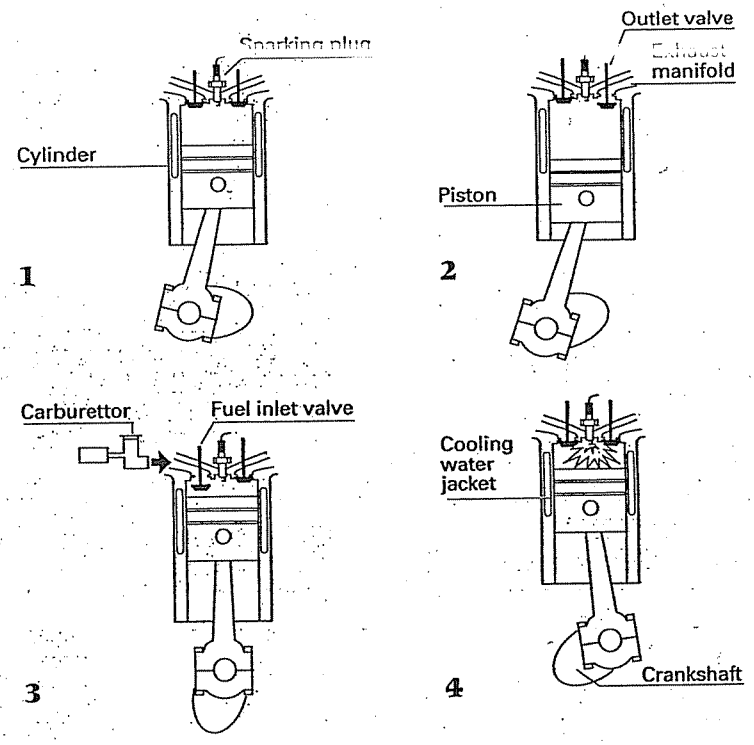


Fig. 2

Language study *Cause and effect, 2*

Study these pairs of actions. What is the link between each pair?

1 The gas expands.
2 This drives the piston down.
3 The piston ascends.
4 This forces the products of combustion out.

There are two links between the actions:

They happen at the same time. We can show this using *As* (see Unit 8).

1+2 ***As** the gas expands, it drives the piston down.*
3+4 ***As** the piston ascends, it forces the products of combustion out.*

One is a cause and the other an effect.

1 Cause: The gas expands.
2 Effect: This drives the piston down.
3 Cause: The piston ascends.
4 Effect: This forces the products of combustion out.

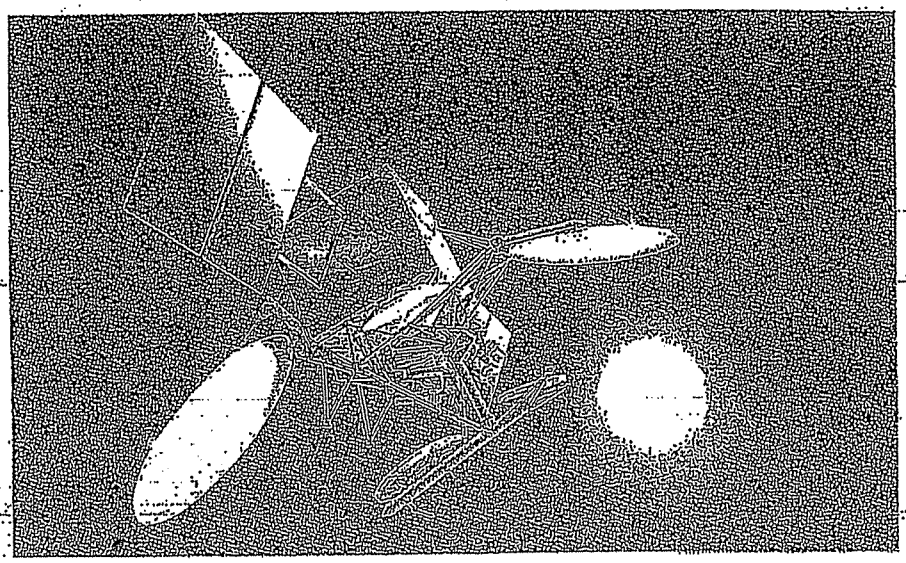
We can show both the time link and the cause and effect link like this:

1+2 *The gas expands, **driving** the piston down.*
3+4 *The piston ascends, **forcing** the products of combustion out.*

Task 5 Link these actions in the same way.

	Cause		Effect
1	The piston moves down the cylinder.	——	This creates a partial vacuum.
2	The piston creates a vacuum.	——	This draws in fuel from the carburettor.
3	The piston moves up the cylinder.	——	This compresses the mixture.
4	The gas expands quickly.		This pushes the piston down.
5	The piston moves up and down.		This rotates the crankshaft.
6	The crankshaft spins round.		This turns the rotor at 3,000 rpm.
7	The armature of the alternator rotates.		This induces a current in the stator windings.
8	The alternator runs at a steady 3,000 rpm.		This generates around 700 watts.

26 Telecommunications



Tuning-in

Task 1 Put these developments in telecommunications in the order in which they were invented. Compare your answer with your partner.

a telex
b communication satellites
c modems
d telegraphy
e television

Now check your answers with Fig. 1 below.

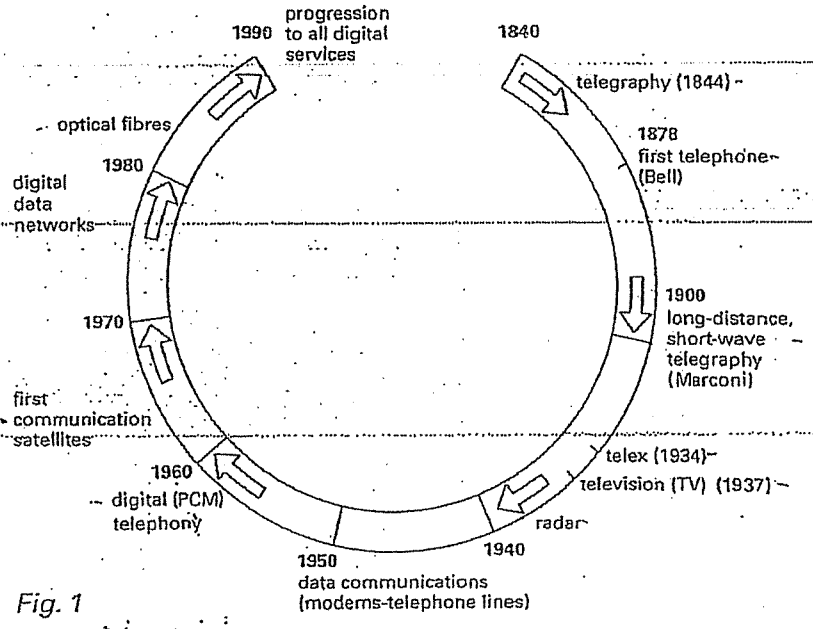


Fig. 1

Task 2

Answer these questions with the help of Fig. 1.

1 Who invented the telephone?
2 What important development in telecommunications took place in the 1960s?
3 What prediction is made about developments in the 1990s?
4 When was telex introduced?
5 What form of telecommunications uses PCM?

Reading *Reading and note-taking*

Taking notes is a good way of remembering the important points in your reading, for either your study or work. When you take notes, you must:

1 identify the main points
2 record them in note form
3 organize your notes so that you can understand them easily when you read them again

A table is one way of organizing notes for easy access.

Task 3

Take brief notes from the text on the significance of the developments in telecommunications during one of the periods listed below. Your teacher will tell you which period to read about. Write your notes in the correct section of the table on page 142.

1 Nineteenth century
2 1901–1945
3 1946–1980
4 1980s on

Telecommunications: a brief historical review

paras

The first true telecommunications system using electrical signals to carry messages started in the 1840s with machine telegraphy. Samuel Morse first developed the telegraph in 1832 but it was not until the mid-1840s that the system was put into practical use – sending coded electrical messages (Morse Code) along the wires. The telegraph became a rapid success, its speed quickly outdating the Pony Express for long-distance communications. 1

The next major step forward came in 1878 with the invention of the telephone by Bell. This enabled speech to be transported as electrical signals along wires and revolutionized personal communications. 2

In 1886, Hertz verified experimentally that electrical energy could be radiated and thus proved the existence of electromagnetic waves. This opened the way for the free-space transmission of information without wires. This provided the basis for all radio and TV broadcasting. 3

In 1901, Marconi established long-distance telegraph communication by transmitting between England and Canada. Although he did not realize it at the time, he achieved such long distances by reflecting radio waves in the ionosphere (layers of ionized gases and electrons existing in the earth's upper atmosphere at heights of 50–500 km). This overcame the problem of transmitting round the earth from one side of the Atlantic to the other. 4

para

With the discoveries of the diode and thermionic valve in the early part of this century, advances were made in both receiver and transmitter design with an associated impact in telegraphy, telephony, and civil and military communications. Radio broadcasting soon followed, with powerful transmitters serving to communicate over wide areas. Television (TV) was first established in 1937. Radar (radio detection and ranging) was also developed from the 1930s and played a vital role in aircraft detection and navigation in World War II. 5

As further advances in technology took place (e.g. the invention of the transistor in 1947 and the subsequent development of microelectronic integrated circuit technology), new applications became feasible, and new systems were developed. 6

Data communications – the transmission of coded data (e.g. text, graphics, financial information) between 'intelligent' terminals and computers – was first established in the early 1950s using modems, equipment which enables the telephone network to convey data as well as speech. Other improvements in materials and devices also led to the transmission of information via cables. Much of today's long-distance telephone traffic is by submarine cable. 7

The space race led to yet another means of long-distance communication, via fixed and mobile earth stations to satellites. Today, several hundred satellites orbit the earth, and satellite links provide all forms of communication and related services such as telephony, data, TV, navigation, meteorology, and surveillance. 8

One of the very latest developments is the optical fibre cable – a tiny glass fibre which can be used to convey signal information by light pulses. Optical fibre cable with extremely low loss at low cost has now been developed with very high data-carrying capacity. Several thousands of telephone messages can be carried down a single fibre. 9

Perhaps the greatest change which has occurred in the last twenty years is that from analogue to digital methods of information transmission. The very first commercially employed telecommunication system, telegraphy, was and still is a digital system. However, telephony, radio, and TV all started as analogue systems. Today, the general trend is strongly towards the digital, and within the next ten years the vast majority of telecommunications systems will be digital. Problems of noise and interference can be combated much more successfully in a digital system. 10

The advances in microelectronics and the merging of communications with computers have led naturally to the digital transmission mode with its advantages of computer control, automatic error checking of signals, excellent memory storage facilities for data, and intelligent terminals. The market need for vast quantities of information transmission and processing at very high speed can only be reliably catered for by using digital techniques. In fact the most rapidly growing field is almost certainly in data communications employing high-speed digital techniques. 11

Development	Significance
Nineteenth century	
telegraphy (Morse)	
telephone (Bell)	
existence of electromagnetic waves proved (Hertz)	
1901–1945	
long-distance telegraphy via ionosphere	
valves	
radar	
1946–1980	
transistor	
data communications	
communications satellites	
1980s on	
optical fibre cable	
change to digital systems	
digital transmission mode	

Task 4

Exchange information with the others in your group to complete all sections of the table. Check with the text if there are any points you do not understand.

Language study *Simple Past* versus *Present Perfect*

Look at paragraph 1 of the text on page 140. Which tense is used most often? Why?

Now look through the text for examples of the Present Perfect. In which paragraphs do you find them? Why is this tense used here?

Study these sentences.

1 *Engineers **developed** optical fibre cables in the 1980s.*
2 *Optical fibre cables **have improved** the telephone system immensely.*
3 *Morse first **developed** the telegraph, a digital system, in 1832.*
4 *Digital systems of information transmission **have replaced** analogue systems in the last 20 years.*

Why is the Simple Past used in 1 and 3 and the Present Perfect in 2 and 4?

We use the Simple Past for events which took place in the past and are complete. Sometimes a day, date or time is given, e.g. *in 1832, on Tuesday.*

We use the Present Perfect for past events which have present results. This tense links the past with the present. Sometimes we use expressions such as *in the last twenty years, since the war, now* to show the link. Using the Present Perfect shows that we think the past events are of current relevance.

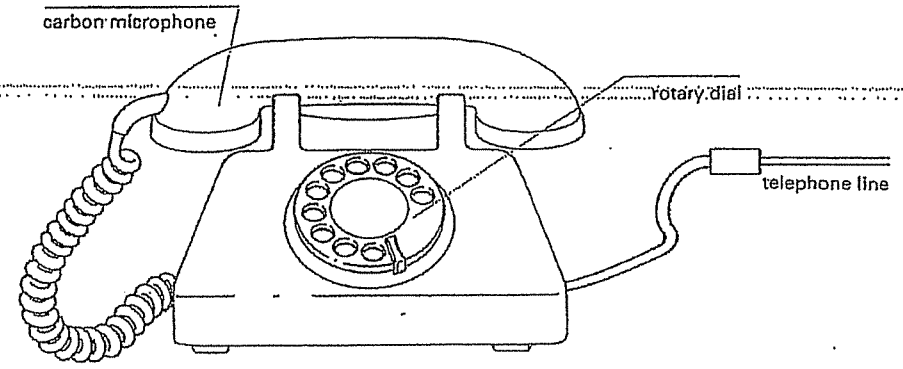
Task 5

Put each verb in brackets in the correct tense and form.

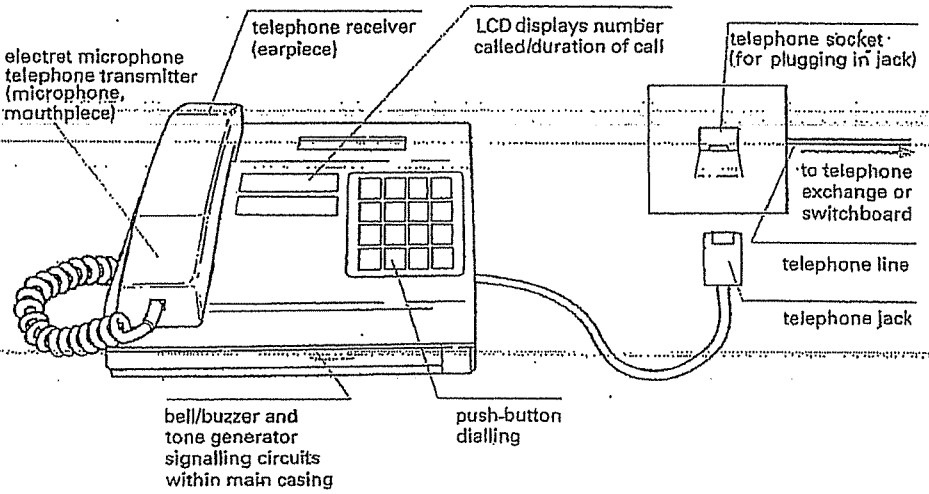
Alexander Graham Bell [1] _____ (invent) the telephone in 1878. He [2] _____ (be) a Canadian whose family [3] _____ (come) from Scotland. Since then, telephone systems [4] _____ (grow) dramatically; in the UK alone there [5] _____ (be) now over 24 million lines. Formerly, the UK system [6] _____ (be) analogue. Many changes [7] _____ (take place) in recent years. Almost the entire UK network [8] _____ (be) now digital. Fibre optic cables [9] _____ (replace) the old copper lines. Previously, telephone exchanges [10] _____ (use) banks of electromagnetic relays for switching. Today, they [11] _____ (have) computer-controlled units. The new network [12] _____ (be) fast and reliable, allowing users access to many other communications services.

Task 6

Study these diagrams of old and new phones. Make a list of any differences. Compare your list with your partner.



older type telephone using rotor dialling, which generates pulses to code digits defining destination



typical push-button type telephone (faster dialling using buttons, which code dialled digits into voice frequency tones to signal destination number).

Task 7

In this description of the changes which have taken place in telephone design, put each verb in brackets in the correct tense and form.

Many changes [1] _____ (take place) in telephone design in recent years. Formerly, telephones [2] _____ (have) rotary dials. A pulse [3] _____ (signal) each dialled number. Now, push-buttons [4] _____ (replace) dials. Each button [5] _____ (trigger) a different audio-frequency tone. This [6] _____ (know) as multi-frequency dialling.

Also, the handset [7] _____ (change). Old models [8] _____ (contain) carbon microphones, which [9] _____ (be) inexpensive and robust but noisy. Today, moving-coil and electret devices [10] _____ (replace) the old microphones.

Advances in technology [11] _____ (allow) additional features to be added to phones. Most now [12] _____ (contain) memories to store frequently-used numbers. Some telephone manufacturers [13] _____ (add) LCDs which [14] _____ (display) dialled numbers and [15] _____ (indicate) the duration of calls.

Technical reading *Transmission lines*

Task 8

Write down any types of cable and transmission lines used in telecommunications that you can think of.

Now read the text to find answers to the following:

1 Why are wires sometimes twisted together in transmission lines?
2 What is the purpose of the dielectric material in coaxial cable?
3 What frequencies can be carried by the following types of transmission lines?
   a coax
   b waveguides
4 What are the advantages of optical fibre cable?

Transmission lines

Telecommunications involves the transmission of information, including voice, data, TV, and radio over long distances. The transmission medium can be free space (ground, space, and sky waves), or the information can be guided between transmitters and receivers using transmission line cables of various kinds. These include:

Parallel wires

This is the simplest type of transmission line consisting of a pair of insulated copper wires running side-by-side and covered by a plastic sheath (see Fig. 1). It is prone to interference and is only used to carry information over small distances such as telephone connections within a building.

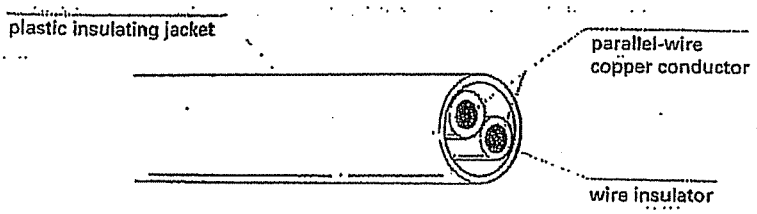


Fig. 1

Twisted pair

Two insulated copper wires are twisted together to reduce interference effects and are enclosed in an insulating polyethylene sheath (see Fig. 2). Because the wires are twisted, unwanted stray signals picked up by one tend to be cancelled by similar signals picked up by the other. They are used for communications over longer distances, for example to connect telephones to their local exchange.

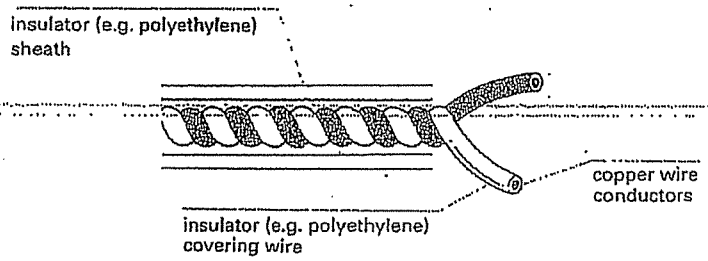


Fig. 2

Coaxial cable (coax)

Flexible coax has a copper wire core surrounded by copper braid. The core and braid are insulated from each other by a dielectric material such as polyethylene and covered by a PVC sheath (see Fig. 3).

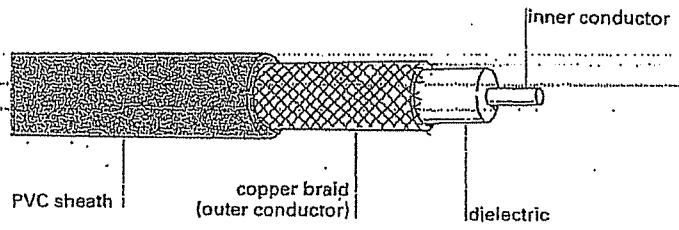
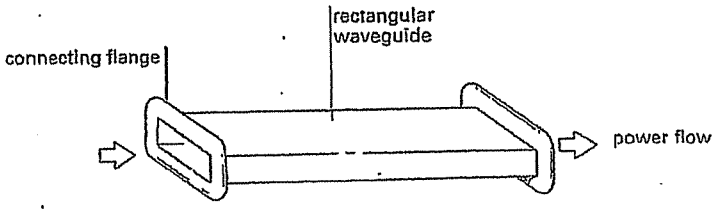


Fig. 3

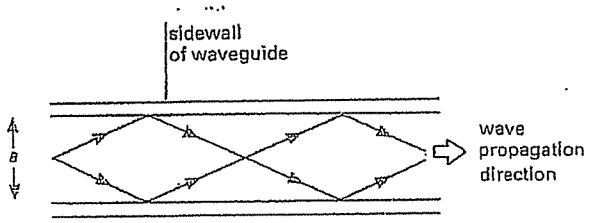
The braid helps to screen the signals from interference. Coax can carry a large number of signals over long distances at frequencies up to 1 000MHz. It is used to connect telephone exchanges and for cable television.

Waveguides

Microwaves can be guided along rectangular copper ducts by a series of reflections from the inner walls (see Fig. 4).



(a) rectangular waveguide for microwave transmission



(b) 'guiding' of electromagnetic waves in a waveguide

Fig. 4

The exact dimensions of the ducts are determined by the frequency to be transmitted. Suitable frequencies are between 1GHz and 300GHz. Waveguides are used to carry microwave signals between dish aerials and receivers.

Optical fibres

An inner core made from very pure silica fibre is surrounded by a similar glass sheath, known as cladding. This is covered by a protective plastic sheath. Non-visible light from lasers or LEDs can travel along the fibre by reflection from the surface where the core and cladding meet (see Fig. 5).

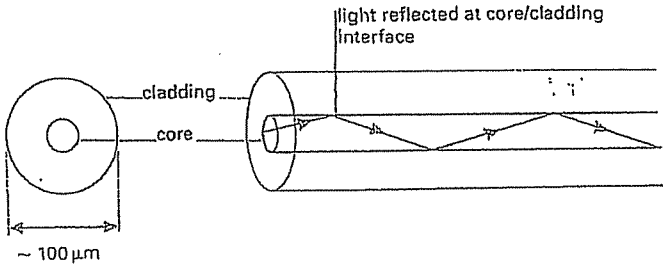


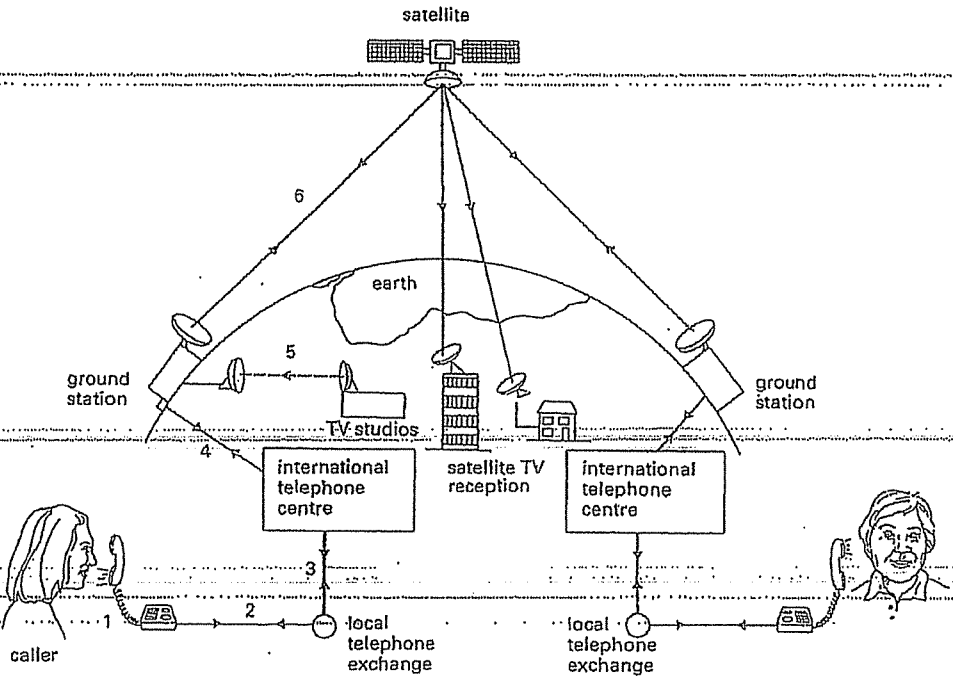
Fig. 5

Although the optical fibre has a smaller diameter than a human hair, it can be used to transmit tens of thousands of signals at high speed with very low loss and no interference from other signals. Optical fibre cable can be used in corrosive environments and is light, flexible and cheap. This type of cable is gradually replacing conventional copper wire for connecting telephones and computer networks.

Task 9 Complete this table using information from the text.

Transmission line	Component materials	Examples of use
_____	_____	telephone connections within buildings
twisted pair	copper wire, plastic insulation	_____
_____	copper wire, copper braid, polyethylene sheath	trunk telephone lines, cable television
_____	copper ducts	_____
optical fibres	_____	_____

Task 10 Using information from the text on transmission lines and from Unit 10, note the transmission medium which could be used for each of the numbered links on this diagram.



Task 4 Which lines in Text 2 contain similar information to the paragraphs in Text 1?

Text 1 paragraphs	Text 2 lines
1	
2	
3	
4	
5	
6	
7	
8	

Task 5 Work in pairs. Discuss which text contains the best explanation. Which is the easier to understand?

Task 6 Find the references in Text 2 for each of the following:

1 a *body* based in France (lines 3–4)
2 *those* made by the same manufacturer (line 5)
3 The latest *machines* (line 7)
4 *This information* is converted (lines 18–19)
5 converts the *binary data* into digital information (lines 21–22)
6 The first machine transmits *these tones* (lines 25–26)
7 *It* sends a signal (in binary code) (lines 28–29)
8 If *the line* is noisy (lines 35–36)

Language study *Reduced relative clauses*

One way of adding extra information to an explanation, or any other text, is to use relative clauses. For example:

1 *The thermal head is a mechanism.*
2 *The head contains a line of dots.*
1+2 *The thermal head is a mechanism* ***which contains a line of dots.***

We can make this sentence shorter by omitting *which* and using an *-ing* clause:

The thermal head is a mechanism ***containing a line of dots.***

Study this example:

1 *The microprocessor converts the information into signals.*
2 *The signals are called analogue tones.*
3 *The signals are suitable for telephone transmission.*
1+2+3 *The microprocessor converts the information into signals,* ***which are called analogue tones, which are suitable for telephone transmission.***

We can make this sentence shorter by omitting *which* + *to be*:

The microprocessor converts the information into signals, ***called analogue tones, suitable for telephone transmission.***

Task 7

Shorten this summary of the technical reading passage in Unit 26, pages 144–6, by reducing the relative clauses where possible.

Transmission lines

The lines which connect telephones within a building are the simplest type of transmission line, which consists of parallel wires. Those which link telephones to a local exchange may be twisted pairs, although these are being replaced. Coaxial cable, which is formed from a copper core which is surrounded by a copper braid, is used to carry a large number of signals over long distances. The cables which provide connections between telephone exchanges are often coaxial. Waveguides, which are made of copper, are used to carry microwave signals between dish aerials and receivers. They are suitable for frequencies which are between 1GHz and 300GHz. Optical fibres, which are made from very pure silica fibre, are the form of transmission line which is most often used these days.

Word study *Short forms*

Some technical words have common short forms. In some cases the short form is used much more frequently than the full form. For example:

Full form	Short form
a facsimile message	*a fax*

Task 8

What are the short forms for these terms?

1 amplifier
2 video recorder
3 television
4 potentiometer
5 coaxial cable

Task 9

What terms are represented by these short forms?

1 puff
2 phones
3 mike
4 CRT
5 phone

Writing *Describing transmission processes*

Task 10

Look at the flowcharts on the following page.

Study Flowchart 1, which describes in note form what happens when a document is fed into a fax machine.

Complete Flowchart 2 to describe how the data is received by the receiving machine. Use the diagram on page 153 and Texts 1 and 2 (pages 154 and 155) to help you.

Reduced relative clauses

5 Link these statements using a relative clause with a participle.

1 a The technology is here today.
  b It is needed to set up a home network.
2 a You only need one network printer.
  b It is connected to the server.
3 a Her house has a network.
  b It allows basic file-sharing and multi-player gaming.
4 a There is a line receiver in the living room.
  b It delivers home entertainment audio to speakers.
5 a Eve has designed a site.
  b It is dedicated to dance.
6 a She has built in links.
  b They connect her site to other dance sites.
7 a She created the site using a program called Netscape Composer.
  b It is contained in Netscape Communicator.
8 a At the centre of France Telecom's home of tomorrow is a network.
  b It is accessed through a Palm Pilot-style control pad.
9 a The network can simulate the owner's presence.
  b This makes sure vital tasks are carried out in her absence.
10 a The house has an electronic door-keeper.
  b It is programmed to recognise you.
  c This gives access to family only.

PROBLEM-SOLVING **6** Work in two groups, A and B. Group A, list all the advantages of a network. Group B, list all the disadvantages. Then together consider how the disadvantages can be minimised.

Group A: Advantages of a network	Group B: Disadvantages of a network

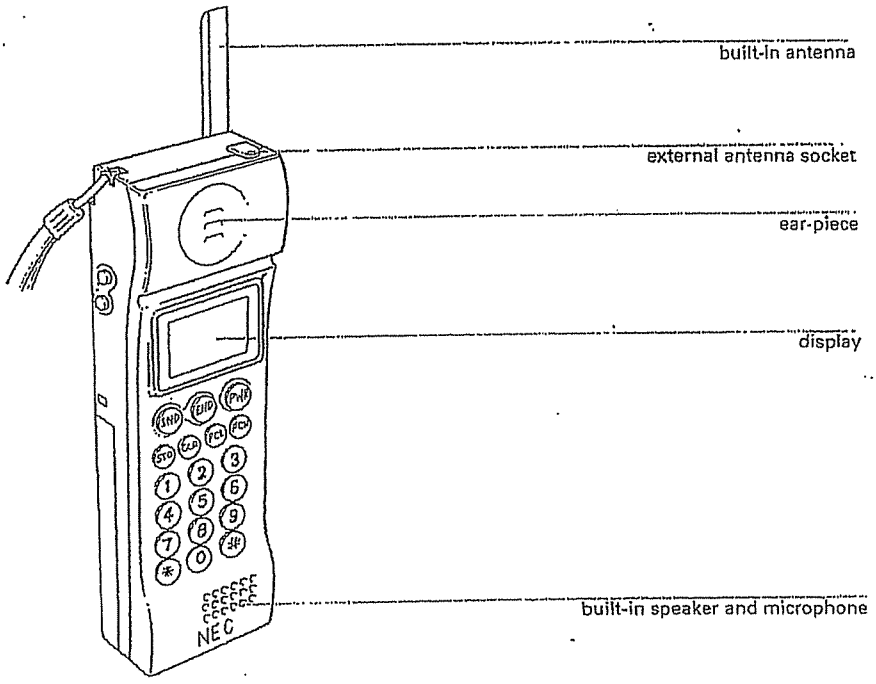
27 Cellphones

Tuning-in

Task 1

Study this diagram of a cellphone. Note the buttons marked:

a SND c PWR e CLR g FCN
b END d STO f PCL



Which buttons would you press for these operations? Justify your answers.

1 switching on or off
2 using one of the programming functions
3 deleting mistakes or individual numbers
4 finishing your call
5 starting your call after keying in the number

Task 2 Check your answers to Task 1 by reading quickly through this text.

Making a call

- Press PWR to turn the P3 on.

To prevent the phone being turned on or off accidentally, you need to hold down the PWR key to operate it.

- Key in the number.
- Press SND.

If you make a mistake when keying in a number and you want to delete the last digit:

- Press CLR briefly.

If you hold down CLR, the whole number will be deleted and the P3 will go back to standby.

You can dial a number of up to 32 digits, although only the last sixteen will be shown on the display at any time. To look at the first part of a number longer than sixteen digits:

- Hold down FCN.

When you have finished the call:

- Press END.

Reading *Recognizing topic, locating detail*

When you are reading to find specific details, it is helpful if you can first identify the part of the text most likely to contain the details you want. If you can identify the best area to search, you have a better chance of finding the details quickly.

Task 3 Glance quickly through the text on the following page to identify which paragraph deals with the following:

a cellphone networks
b how signal levels are controlled
c how the MSC locates a cellphone
d limitations of mobile phone systems
e frequency distribution within cells and clusters
f the development of mobile phones
g how cellphones link with other cellphones and with the telephone system

Task 4

Decide which paragraphs are most likely to contain answers to these questions. Compare your decisions with your partner, then search for the answers.

1 Who uses mobile phones?
2 What does the MSC register of cellphones contain?
3 What is the difference between a mobile phone and a cellphone?
4 Why is a cellphone called a cellphone?
5 How large is a cell?
6 How does the MSC prevent interference due to too strong a signal level?
7 What's the best number of cells to form a cluster?
8 When were radiophones developed?
9 How does an MSC ensure that a cellphone is using the right frequency for a call?
10 What is the MSC permanently connected to?

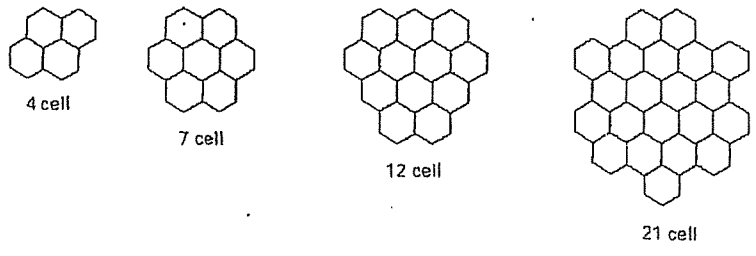
Cellphones

para

Radiophones, using the VHF band, were developed during the Second World War to provide communications for ships and aeroplanes. At the end of the war they were further developed as mobile phones for use by the emergency services and other services such as taxis. 1

With mobile phone systems, all communications take place through a central control base station. Mobile units normally do not communicate directly with other mobile units. They send messages to the control base station and the base station controller relays the messages to other mobile units. Although mobile phones can be moved, they must stay within fixed areas. This type of system is limited by the fact that there are not enough VHF frequencies available for large numbers of communications between individual users. 2

The problem of a lack of suitable frequencies can be overcome by using a cellphone network. A cellular phone (cellphone) is a lightweight, portable radio transceiver which can transmit and receive telephone calls anywhere in the cellular network area. In the network, the same frequencies can be used for many different telephone calls at the same time. To achieve this, each communications area is divided into a number of hexagonal-shaped cells, as shown in Fig. 1. 3



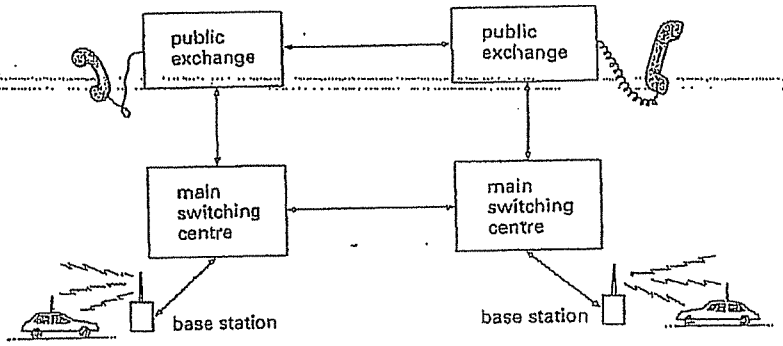
cell clusters

Fig. 1

para

Each cell is allocated a number of frequency channels for communications. Although the frequencies used in any one cell are not used in its neighbouring cells, the same frequencies can be used in cells further away without causing interference. The size of the cells vary between 1 km to about 30 km across, depending on the output power of the cellphone transmitters. Each area can have a different number of cells, but a cluster of seven cells gives a good compromise between the number of frequency channels available in each cell and the interference between communications in different cells. 4

Each cell has a small electronic base station situated in a public place such as a car park or shopping centre. All the base stations for a cluster of cells are permanently connected to a main switching centre (MSC). This contains a computer to select suitable frequencies and control the communications for that cluster of cells. The MSC is also connected to other MSCs and to the public telephone exchange, allowing cellphones to make calls or receive calls from other cellphones and fixed telephones throughout the whole telephone system (see Fig. 2). 5



mobile and fixed networks

Fig. 2

The MSC keeps a register of cellphones indicating their cell position. If the cellphone moves to another cell, its new position is signalled to the MSC. In this way, the MSC knows where to send signals to contact each cellphone. When a call is made to a cellphone, the MSC first checks the registrations to find the position of the cellphone. It then pages the cellphone and causes it to tune to the allocated frequency channel. The cellphone then begins sending an 8kHz signal to the base station. When the user takes the call, the 8kHz signal is discontinued and the speech channel is enabled. 6

The base station constantly monitors the signal level of a call. If the signal level becomes too strong it will cause interference to other users. To prevent this, the power level of the cellphone is automatically reduced. If the signal level becomes too weak, the MSC tests the signal strength from neighbouring base stations and switches the call to another base station and speech channel if necessary. This may cause a period of silence of up to about 400 ms while the switching takes place. 7

Writing *Linking facts and ideas, 6*

Task 5

Study these statements about making a cellphone call. Link them into longer sentences. You may omit words and make whatever changes you think are necessary in the word order and punctuation of the sentences.

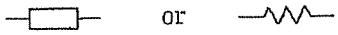
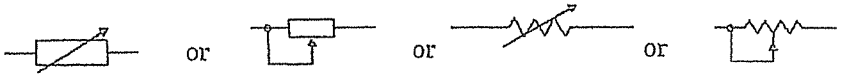
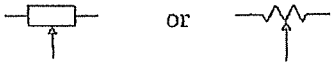
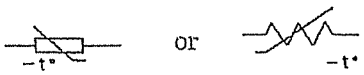
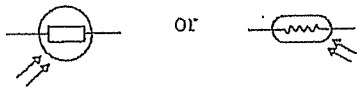
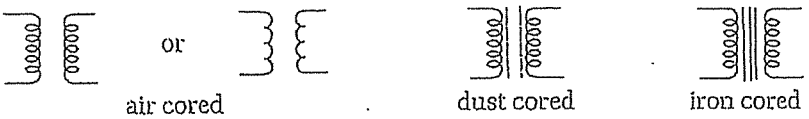
1 A call is made from a cellphone.
2 The cellphone scans the available frequencies.
3 The cellphone finds the strongest signal to the nearest base station.
4 The cellphone detects that the base station is idle.
5 The cellphone transmits the required dialling code.
6 If the code is received, ...
7 ... the base station sends a signal back to the cellphone.
8 The signal indicates a suitable frequency channel for the call.
9 The cellphone tunes to the allocated channel.
10 The cellphone user hears the ringing tone.
11 The call is answered.
12 The user can speak and listen using the cellphone, as with a normal telephone.
13 The call is finished.
14 The cellphone signals to the base station.
15 The cellphone sends a short burst of signal at 8 kHz.
16 If the code is not received, ...
17 ..., the cellphone abandons the call.
18 ... the cellphone tries again later.

Appendix 2
Circuit symbols

Notes

1 A number of variations of circuit symbols are commonly found. For example, —∿∿— is still often used although it is no longer the international symbol for a resistor.

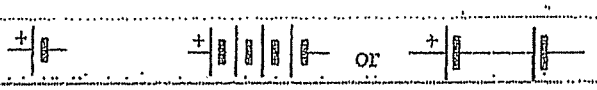
2 Some symbol details are often left out in circuit diagrams. For example, the 'a' and 'k' labels and the circle on diodes are not always shown.

Component	Common symbols
1 fixed resistor	
2 variable resistor	
3 potentiometer	
4 thermistor	
5 LDR	
6 capacitor	 fixed; electrolytic; variable
7 inductor	 air cored; dust cored; iron cored
8 transformer	 air cored; dust cored; iron cored

9 aerial

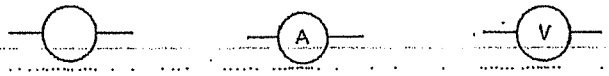
10 earth

11 cell/battery



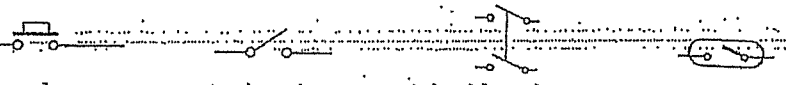
cell battery

12 meter



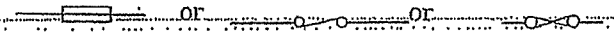
meter ammeter voltmeter

13 switch



push single pole double pole reed

14 fuse

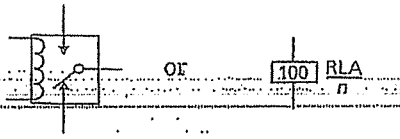


15 microphone

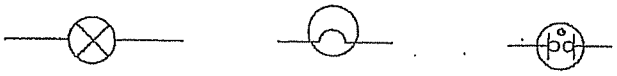
16 loudspeaker

17 bell

18 relay



19 lamp

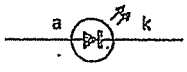


signal illuminating neon

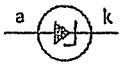
20 electric motor

21 crystal

22 diode

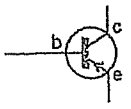


LED

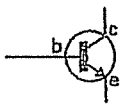


zener

23 bipolar transistor

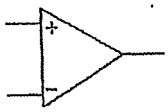


PNP

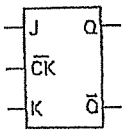


NPN

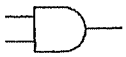
24 op amp



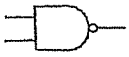
25 J-K flip-flop



26 logic gate

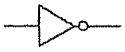


AND



NAND

OR



NOT