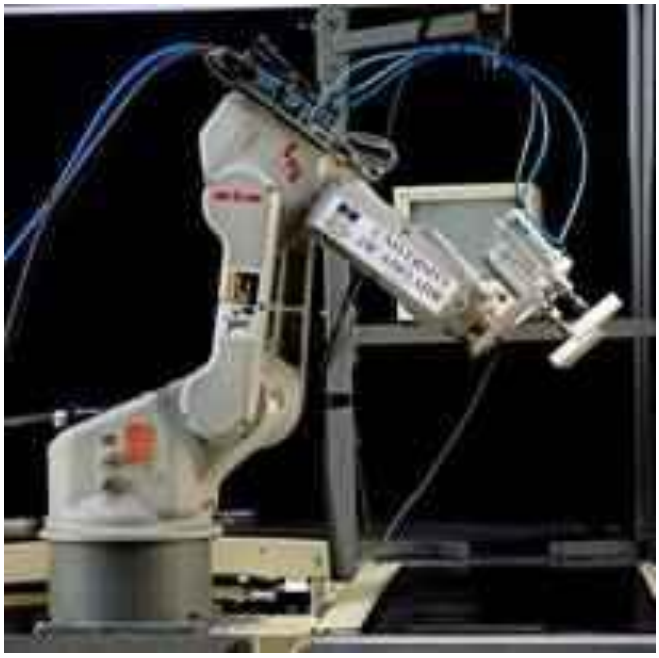
FB Grundlagenwissenschaften
Sprachlehrzentrum

Fachhochschule Jena
University of Applied Sciences Jena

Mechatronics/Electrical Engineering - Technical English II



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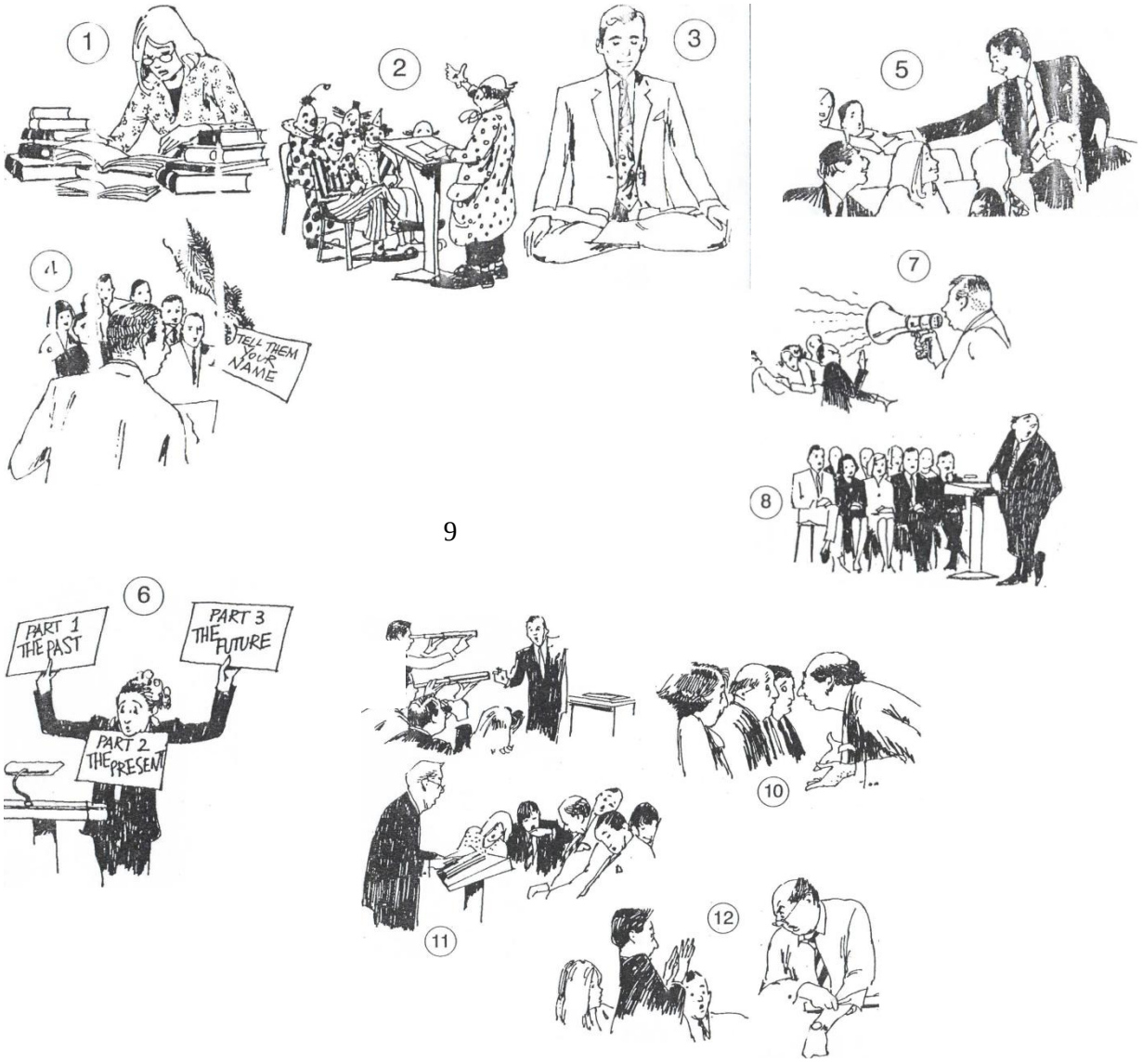
Unit 1 Presentations

1. *What makes a good presentation?*

Brainstorming: List all things you can think of.

Match the pictures (1-12) with the instructions for making good presentations.



a) **It is important to maintain eye contact with the people you are talking to.**
b) **Clearly signal the structure of your talk during the introduction.**
c) **Select and order your material carefully during the preparation stage of your presentation.**
d) **Use the right body language to get your message across.**
e) **Dress appropriately.**
f) **Difficult questions should always be handled politely and diplomatically.**
g) **Establish a positive relationship with your audience as quickly as possible.**
h) **People will lose interest if you do not move your talk along at a lively pace.**
i) **Take a few deep breaths before you start, to help you overcome your initial nervousness.**
j) **Use your voice effectively to keep people involved.**
k) **Make sure your visual aids are clear and easy to follow.**
l) **Design and position your notes so that you can refer to them easily at all times.**

2. ***Structure***

Task1 *Which parts belong to a presentation?*

Order them as they would appear in a presentation.

summary / questions / introduction / outline / main parts (1, 2, 3…) / conclusion

1.

2.

3.

4.

5.

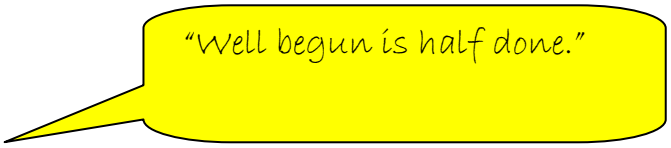
6.

Task 2 *Choose the right category (1.-10.) for the examples (a.-j.) of presentation language below.*

1. Asking rhetorical questions	a. Did you realize ... (quote amazing facts) As (famous person) once said ... I´d like to start by telling ... (joke, anecdote)
2. Describing results	b. Today I will be talking about ... My talk will focus on the ... I´m here today to tell you about ...
3. Giving background information	c. First, I´m going to ... Then ... My presentation is divided into ... First of all, ... secondly, ... after that ...
4. Describing action taken	d. I´d like to begin by giving you some ... Some time ago we were ... Let´s have a look at some background ...
5. Opening strategies	e. So, what could we do? How did we deal with the problem? Where did we go from there?
6. Describing problems	f. Well, the difficulty was ... The problem we were facing ... Our highest challenge was ...
7. Structuring	g. Therefore, we decided to ... There were basically three choices of action ... Our first priority was ...
8. Forecasting	h. Here are the preliminary results. If you have a look at this diagram, you can see ... Have a look at the following outcome.
9. Summarizing	i. To sum up ... Let me briefly recapitulate: ... In conclusion
10. Closing	j. Thank you very much for time and attention. That brings me to the end of my talk. If you have any questions, I´ll be happy to answer them now.

(taken from Milestones)

3. ***Introductions***



- Introduction (10%)
- Body (80%)
- Summary and conclusion (10%)

The first impression counts. You can win or lose your audience in the first few minutes. Hook your audience to create an impact that will engage them and build interest for the whole presentation:

- surprise your audience (Did you know...?)
- make an offer (...that`s what I intend to do today.)
- use rhetorical questions (Why quality? Because without it, you can`t succeed.)
- choose an appropriate quotation

THE CLASSIC INTRODUCTION

TASK 1

Introducing yourself and your talk: These parts belong to the introduction phase.

Find headings for the phrases of each group. The following keywords may help you:

name and job position, greeting, objective, reference to audience
presentation title and / or subject
timing, structure, time for questions

1. ……...

- Good morning. My name is… I'm the new Finance Manager.
- Ladies and gentlemen. It's an honour to have the opportunity to address such a distinguished audience.
- Good morning. Let me start by saying just a few words about my own background. I started out in…
- Welcome to Standard Electronics. I know I've met some of you but just for the benefit of those I haven't, my name is…

2. ……...

- I'd like to talk (to you) today about…
- I'm going to present the recent…
  explain our position on…

brief you on…
inform you about

the subject/ focus/ topic of my talk/ presentation/ paper (academic)/ speech (usually to public audience)

3. ……

- We are here today to decide…/ agree… / learn about…
- The purpose of this talk is to update you on…/ put you in the picture about… / give you the background to…
- This talk is designed to act as a springboard for discussion/ start the ball rolling.

4. ……

- I shall only take (…) minutes of your time.
- I plan to be brief.
- This should only last (…) minutes.

5. ……..

- I've divided my presentation into four parts/ sections. They are…
- The subject can be looked at under the following heading:…
- We can break this area down into the following fields:…
- Firstly/ first of all… / Secondly/ then/ next …
- Thirdly/ and then we come to…
- Finally/ lastly/ last of all…

6. ……..

- I'd be glad to answer any questions at the end of my talk./ If you have any questions, please feel free to interrupt.
- Please interrupt me if there's something which needs clarifying. Otherwise, there'll be time for discussion at the end.

7. ……

- I can see many of you are…
- I know you've all travelled a long way.
- You all look as though you've heard this before.

Task 2:

Complete this presentation introduction with words from the list.

(l) talk about
(2) questions
(3) hear
(4) look at
(5) brief talk
(6) act as
(7) points of view
(8) finally
(9) go along

Good afternoon and thank you for making the effort to be here with us today. My name's Rachel Rawlins and I'm responsible for public affairs. What I'd like to do today is (a) _____ our recent corporate campaign. This (b) _____ will hopefully (c) _____ a springboard for discussion. I'm going to (d) _____ the corporate campaign from three (e) _____ firstly, the customers; secondly, the financial institutions; and (f) _____, the shareholders. If you have any (g) _____ , just interrupt me as I (h) _____ . Your point of view may well be different, and we'd like to (i) _____ from you.

Task 3

Introductions can become repetitive. It's important to have a choice of words and expressions at your fingertips.

Use one of the following expressions to replace each of the expressions in italics in this introduction.

don't hesitate/ I'm delighted/ in more depth/ a chance/ sections/ my purpose is/ I take care / go through/ divide

Good morning ladies and gentlemen. *It's a pleasure* to be with you today. My name's Gordon Matthews and *I' m in charge* of corporate finance at our headquarters here in Brussels. *We are here* today to *review* some key figures and to outline financial strategy over the next five years. So what I intend to do is to *break down* this presentation into three *parts*: first, the financial review; second, the options facing us; and finally, the strategy I propose. If you have any questions, please *feel free* to interrupt me, but I should also say there'll be *an opportunity* to discuss issues *at greater length* after my talk.

Communication experts are all agreed that **the first three minutes** of a presentation are the most important. They talk about ´**hooks´-** simple techniques for getting the immediate attention of the audience. A good start makes you feel more confident.

Look at the presentation openings below and divide them under three headings: problems (P), amazing facts (F), stories (S)

1. **Did you know that** Japanese companies spend four times more on entertaining clients in a year than the entire GDP of Bulgaria? 40 billion dollars, **to be precise. You know, that´s** twice Columbia´s total foreign debt. You could buy General Motors for the same money.
2. **Suppose** your advertising budget was cut by 99% tomorrow. **How would you** go about promoting your product?
3. **According to the latest study,** by 2050 only one in every four people in Western Europe will be going to work. And two will be old age pensioners.
4. **You know,** R&D is 90% luck. **When I think about** creativity, **I`m reminded of** the man who invented the microwave oven. He spent years messing around with radar transmitters, then noticed the chocolate in his pocket was starting to melt.
5. **Statistics show that** in the last ten years more people have legally emigrated to the United States than to the rest of the world put together- about half a million of them a year, **in fact. Now,** over ten years, **That´s roughly equivalent** to the population of Greece.
6. **I read somewhere the other day** that the world´s highest paid executive works for Disney and gets $230 million a year. **Now that´s about** $2000 a minute! **That means** he´s currently making more money than Volkswagen.
7. **How many people here this morning** hate going to meetings? Just about everybody, **right**? Well, imagine a company where there were any meetings and everything ran smoothly. **Do you think that´s possible?**
8. **Have you ever been in the situation where** you´ve had to negotiate with Japanese? **I remember when** I was working in Nagoya and everybody had told me that the Japanese don´t like saying `no`. So in meetings I just kept saying `yeah` to everything. And they hated it. **It turned out** `yeah` sounds like `no` in Japanese!

Choose a presentation you have given recently or you are preparing to give. Prepare and give the introduction. Try to find a hook.

4.Delivering

Communication (Albert Mehrabian, psychologist and author): 7% **verbal** (words we use) 38% **voice** (tone, volume, etc.) 55 % **body language**

You can argue about these percentages, but successful presenters clearly manage all three elements well.

A) Verbal

language is the packaging for your message

Clarity:

- structure your presentation
- use signalling language to guide your audience (that brings me to the end of the first section...)
- KISS - principle (keep it short and simple)

Impact:

be persuasive:

- repeating (repeat key points, use synonyms)
- contrasting (last year was... this year is...)
- simplifying: simpler language can communicate more effectively
- questioning: rhetorical questions vary your rhythm (So, what is the problem? The problem is money.)
- energizing: add energy by punctuating strongly with filling words: (Ok.../ So.../ Right...)
- engaging: establish rapport with your audience by including an interesting personal anecdote.

Personal style:

style of delivery

- know your strengths and weaknesses and adapt to the needs of your audience
- don`t make sounds like "er" or "uh" when you hesitate - it`s very distracting

B) Voice

use your voice effectively

- volume (too low, too loud)
- speed (too slow, too fast)
- intonation (too boring, too excited)
- use sentence stress, pauses, rhythm to create a natural, dynamic delivery

Example:
Stress the underlined word. What is the difference?
This course will help you become a better presenter.
This course will help you become a better presenter.

TASK 1 *Look at the clues in brackets and underline the word which should be stressed in each sentence.*

a. Clearly, we need to look at this again. (*it's obvious*)
b. Clearly, we need to look at this again. (*twice wasn't enough*)

c. We will never get such a perfect opportunity again. (*this is our only chance*)
d. We will never get such a perfect opportunity again. (*but perhaps the competition will*)

e. I'd like us to work out a strategy. (*and nobody else*)
f. I'd like us to work out a strategy. (*a plan is important*)

g. There hasn't been a dramatic increase in production costs. (*but there has been an increase*)
h. There hasn't been a dramatic increase in production costs. (*the increase was in personnel costs*)

i. I think we've made a good start. (*but you might not agree*)
j. I think we've made a good start. (*but there is still a lot to do*)

C) Body language

TASK 2 *Watch version 1 and 2 of the video. As you watch, take notes on Dr. Linden´s body language. Use the checklist to help you*

	Version 1	Version 2
General appearance		
Hands- position		
Hands- gestures		
Eye contact		
Facial expression		
Movement		

D. Linking

It is important to link your parts correctly. Otherwise your audience may not be able to follow you.

Task 3

What do the following expressions refer to? Match them with the keywords given.

Contrasting ; Giving reasons/ causes; Generalizing; Highlighting; Summarizing; Comparing ; Concluding ; Sequencing/ Ordering; Contradicting; Giving examples

a) firstly. .. secondly... thirdly.../ then... next... finally/lastly...
let's start with/ let's move/go on to.../ now we come to.../ that brings us to.../ let's leave that.../ let's get back to...

b) therefore/ so
as a result/ that's why

c) but
however

d.) similarly
in the same way

e) in fact
actually

f.) to conclude
in conclusion

g) to sum up
in brief
in short

h) in particular
especially

i) for example
for instance
such as

j) usually
generally
as a rule

Task 4

Link the ideas in the following sentences by adding an appropriate word or phrase. The first one has been done for you as an example.

a. That was a good meeting. *(By the way....)*
Did I tell you about the match last night?

That was a good meeting. By the way did I tell you about the match last night.

b. Our competitors are becoming stronger.
One of them, Falcon, has a joint venture with a Japanese firm.

c. This year we have lost market share.
We expect to remain No. 1 in the market.

d. There are some vital factors to consider.
The risk of a take-over bid.

e. Falcon has reduced its costs by relocating.
We must consider cutting the cost of our premises.

f. We've had a difficult year.
We've still made a healthy profit.

g. We expected to lose money in the Far East.
This was our most profitable market.

h. The yen dropped against the dollar.
We made considerable profits on the exchange rate.

4. Visual aids

Task 1

Watch version 1 and 2 of the video. What do you have to consider when designing and delivering visuals?

Dos	Don´ts

Task 2

Compare the visuals, their advantages and disadvantages.

	advantage	disadvantage	things to consider
blackboard/ whiteboard			
overhead projector/ slides			
flip chart			
handout material			
computer projection, ppp			
physical items passed around			
Video/ DVD			

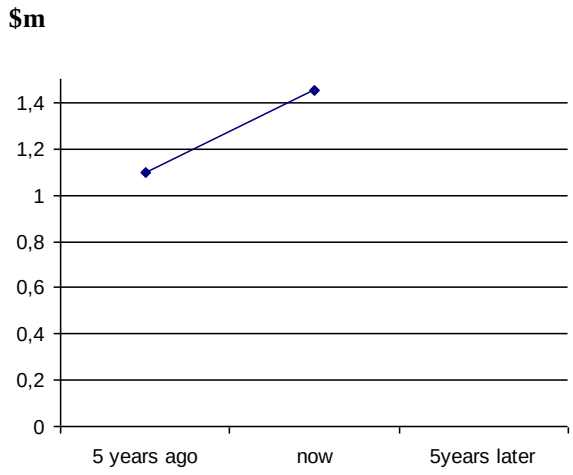
TASK 3

Match parts from each column to make sentences used to refer to media.

1 On the next page	**a** from this picture, the design is absolutely new.
2 My next slide shows	**b** customers have complained about the service.
3 As you can see	**c** how much the market has changed.
4 Let me just show you some	**d** I'll show you our latest poster.
5 To illustrate this	**e** at the figures on the next page.
6 Let's now have a closer look	**f** which shows the market development in 2007.
7 Here we can see how many	**g** interesting detail.
8 I have a slide	**h** you will see a photo of the new YXZ model

Task 4

You are going to hear Francesca Rocca, Finance Director of Marvotto, talking about turnover figures. As you listen, write the information she presents on Graph 1 below.



____ turnover

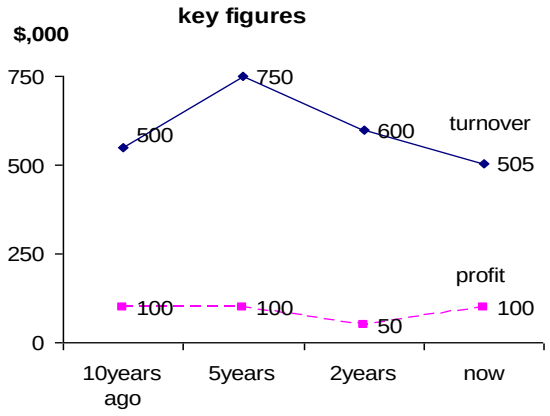
------ sales to Germany

Complete this description with information from Graph 2 below.

I'd like to draw your attention to some key figures. On this graph, I have [1]_____ both profitability and turnover. The [2]_____ line represents turnover and the [3]_____ one represents profits over the last ten years. As you can see, ten years ago our turnover stood at £ 550,000. Over the next five years it [4]_____ steadily. It reached a peak of £750,000 five years ago

and, unfortunately, since then it has [5]_____. It now stands back at £550,000.

Let's look at the profit figures for a minute. During the same period, profits [6]_____. There was a slight [7]_____ in 1993, but otherwise we have [8]_____ our profitability throughout this period.



5. ***Finishing well***

We remember best what is said at the beginning and at the end of a presentation

A **strong finish** is therefore essential

- summarize clearly the main points of your talk
- have a simple, short message your audience will remember and have time for questions

'So, before we move on to discuss these matters, let me just summarize the main issues. Firstly. .. secondly... thirdly. .. So, I suggest we take things in that order. .. Before we start, are there any questions you'd like to ask?'

JOANNA BROOKES

Task 1

You are going to hear the final part of four different presentations. As you listen, decide which presentation each extract comes from, and complete the table.

Presentation	**Extract**
The Sales Presentation (by a salesman to a group of prospective customers)	
The Welcome Presentation (to a group of visitors to a plant)	
The New Idea Presentation (to a group of managers)	
The Motivation Presentation (by a Personnel Director to a group of new employees)	

Language Focus

Signalling the end

- *That brings me to the end of my presentation.*
- *That completes my presentation.*
- *Before I stop/finish, let me just say…*
- *That covers all I wanted to say today.*

Summarizing

- *Let me just run over the key points again.*
- *I'll briefly summarize the main issues.*
- *To sum up...*
- *Briefly…*

Recommending

- *So, I would suggest that we. . . / In my opinion, the only way forward is to . .*
- *I'd like to propose...* (more formal)

Concluding

- *As you can see, there are some very good reasons...*
- *In conclusion…*
- *I'd like to leave you with the following thought/idea.*

Inviting questions

- *I'd be glad to answer any questions.*
- *So, let's throw it open to questions.*
- *Any questions?*

Closing

- *Thank you for your attention.*
- *Thank you for listening.*
- *I hope you will have gained an insight into...*

Task 2

The sentences a-e below are the end of a presentation, but they are in the wrong order. Put them into the right order.

a. So, I'd now be glad to answer any questions.

b. I sincerely hope you'll all go away with a more complete picture of the principal activities of UNEXCO.

c. Very briefly, there are three. Firstly, fund-raising; secondly, publicity; and thirdly, political lobbying.

d. So, that brings me to the end of this presentation.

e. Finally, I' d like to leave you with something which I heard recently. 'You can't please all the people all the time, but we should certainly be able to feed all the people all the time.'

Task 3

Match 1-7 with a-g to make final statements from conclusions.

1 To put it in the words of Albert Einstein	A "Look for your choices, pick the best one, then go with it."
2 I would like to finish my talk	B with an important question.
3 Let me go back to	C about the new branch in Tokyo?
4 So now it's	D get down to work!
5 Remember that story I told you	E what I said at the start of this talk.
6 As the famous basketball coach Pat Railey said:	F "The important thing is not to stop questioning."
7 OK, and now let's	G up to you.

6. *Question phase*

The questions phase is the most challenging, least predictable part of presentation.

- try to anticipate the questions
- remain confident and appear authoritative

RACE - a step by step guide of what to do:

R = Respond

1. positive respond or clarification of the meaning of the question

A = Answer

2. keep your answer concise, link back explicitly to something you said in your presentation

C = Check

6. check with questioner that you have answered the question
7. ask questioners for their thoughts and opinions

E = Encourage

8. invite or ask for more questions
9. allow time
10. never say: I don`t know. Offer to find the answer
11. throw back hostile questions with the question: What do you think?
12. Don`t enter into a debate with one person

7.Language Practice

Task 1 *Complete the following presentation excerpts with suitable words from the boxes.*

after that / finally / to start with / specifically / outline / bring you up to date / illustrate / purpose / then / thank /sum up / describe / tell you / concluding

"Good afternoon, everybody. I' d like to [1]_____ you all for being here.

My [2]_____ today is to [3]_____ about our corporate strategy for the next decade, and, more[4] _____ , to [5]_____ with our plans for Europe."

[6]_____ I'd like to [7]_____ briefly our current marketing policy in the UK. [8]_____ I' ll [9]_____ some of the problems we' re having over market share. [10] _____ I'll [11]_____ the opportunities we see for further progress in the 21st century. [12] _____

I' ll quickly [13]_____ before [14]_____ with some recommendations."

indicated / talked / you will notice / draw your attention / interrupt / move on / options / priority / referring / in conclusion / recommend / pointed out

"Please feel free to [15]_____ me if you have any questions at any time."

"Now I' d like to [16]_____ to Chart B showing our sales revenue and pre-tax profits over the last ten years. [17]_____ that although turnover has risen, our profits have not increased at the same rate."

"I've [18]_____ about our current position in the UK and I' ve [19]_____ some of the problems we are facing. Well, what [20]_____ are open to us now? Where do we go from here?"

"As I have already [21]_____ , I think our main [22]_____ must be to build on the excellent results we have achieved in certain European markets. I' m [23]_____ , of course, to Italy and Spain. Let me quickly expand on those successes before we [24]_____ ."

"We should not forget the French market. Admittedly our results there have been poor so far, but there are signs the market is changing and we can learn a lot from our mistakes. On balance though, I think we stand to gain most from concentrating on southern Europe and I strongly [25]_____ we put all our efforts into further expansion in Italy, Spain and possibly Greece.

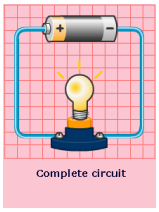
[26]_____ , may I thank you all for being such an attentive and responsive audience. Thank you also for your interesting questions. Are there any final questions?"

Unit 2 Basic electrical engineering

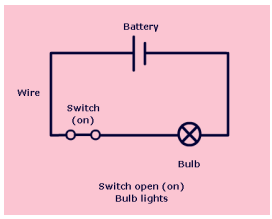
1.Circuits

Task1 *Put the following 20 words and phrases into the statements below.*

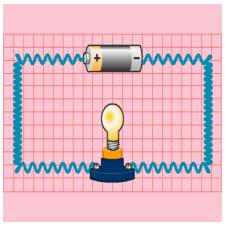
blows • breaks • brighter • brighter • buzzers • complete • completes • conductors • conducts • dimmer • greater • insulator • insulator • negative • negative • positive • positive



1. A circuit always needs a _____**1)**, such as a battery, with wires connected to both the _____**2)** (+) and _____**3)** (-) terminals/ ends.
2. A circuit can also contain other electrical components, such as bulbs, _____**4)** or motors, which allow electricity to pass through.
3. Electricity will only travel around a circuit that is _____**5)**, i.e. has no gaps.
4. Two batteries provide a _____**6)** flow of electricity than one.



5. Closing the switch _____**7)** the circuit so electricity can flow.
6. Opening the switch _____**8)** the circuit so electricity cannot flow to the bulb.
7. The higher the voltage of the battery, the _____**9)** the bulb.
8. A bulb may flash and go out when a 1.5V battery and a 3V battery are both connected across it in a simple series circuit, because much electricity flows through the bulb's filament. It heats up and _____**10)**/ burns out.
9. What is the effect of changing the wire in a circuit from a straight thick wire to a longer (coiled) thick wire? The bulbs become _____**11)** because a long wire provides more _____**12)** than a short wire.



10. A battery is represented by a long line and a short line in a circuit diagram. The long line represents the _____**13)** terminal of the battery; the short line, the _____**14)** terminal.
11. Adding more batteries to a simple circuit will make a bulb _____**15)**.
12. _____**16)** are materials, such as metals, that allow electricity to pass through them.
13. A material that does NOT let electricity pass through it is called an electrical _____**17)**.
14. Electrical wiring is usually made from copper because copper _____**18)** electricity.
15. Electrical wiring is usually covered with a layer of plastic which is an _____**19)** and so _____**20)** the electricity from flowing anywhere else but through the wires.

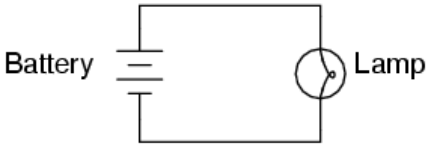
Series and parallel electrical circuits are two basic ways of *wiring* components. The names describe the method of attaching components, that is one after the other or next to each other. It is said that two circuit elements are connected in *parallel* if the ends of one circuit element are connected directly to the *corresponding* ends of the other. If the circuit elements are connected end to end, it is said that they are connected in *series*. A series circuit is one that has a single path for *current flow* through all of its elements. A parallel circuit is one that requires more than one path for current flow in order to reach all of the circuit elements.

As an example, consider a very simple circuit consisting of two *light bulbs* and one 9 V battery. If a wire joins the battery to one bulb, to the next bulb, then back to the battery, in one continuous loop, the bulbs are said to be in series. If each bulb is *wired* to the battery in a separate loop, the bulbs are said to be in parallel.

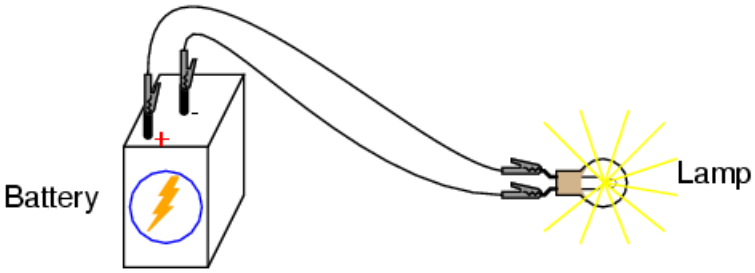
Taken and adapted from wikipedia.org

Task 2 *Compare series and parallel circuits*

SCHEMATIC DIAGRAM



ILLUSTRATION

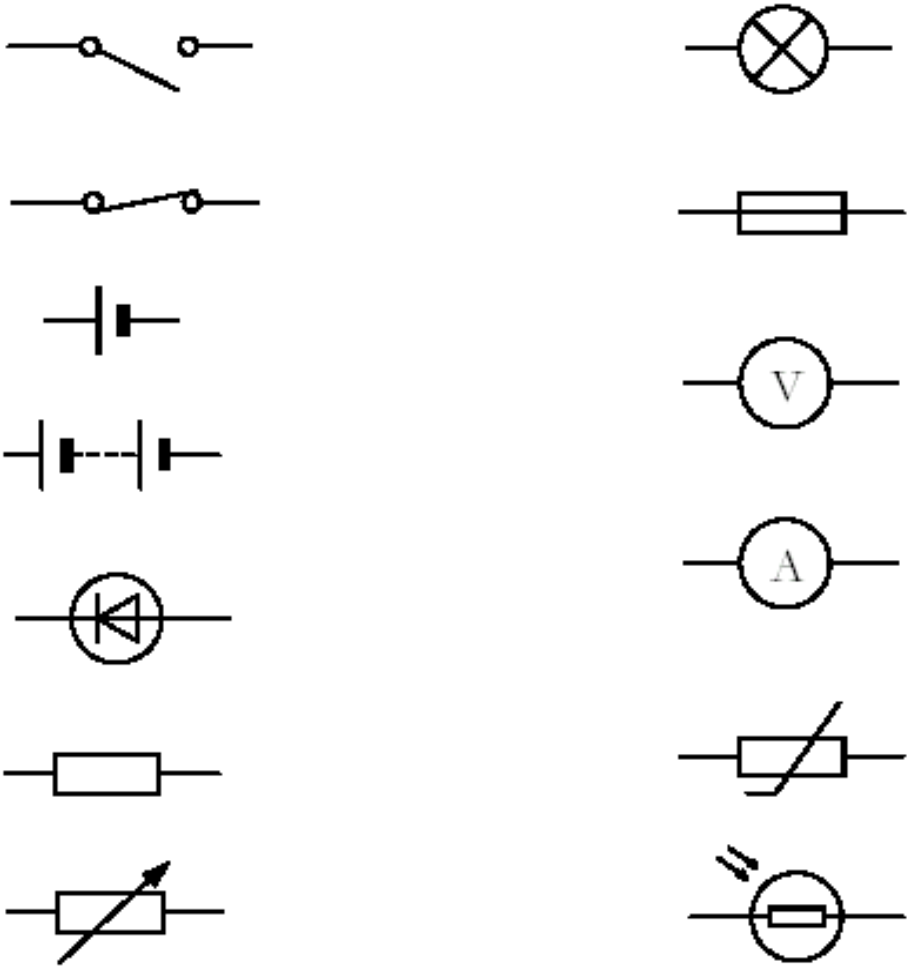


This is the simplest complete circuit in this collection of experiments: a battery and an *incandescent* lamp. Connect the lamp to the battery as shown in the illustration, and the lamp should light, *assuming* the battery and lamp are both in good condition and they are matched to one another in terms of voltage.

If there is a "break" (*discontinuity*) anywhere in the circuit, the lamp will fail to light. It does *not* matter where such a break occurs. Many students assume that because electrons leave the negative (-) side of the battery and continue through the circuit to the positive (+) side, that the wire connecting the negative terminal of the battery to the lamp is more important to circuit operation than the other wire providing a return path for electrons back to the battery. This is not true.

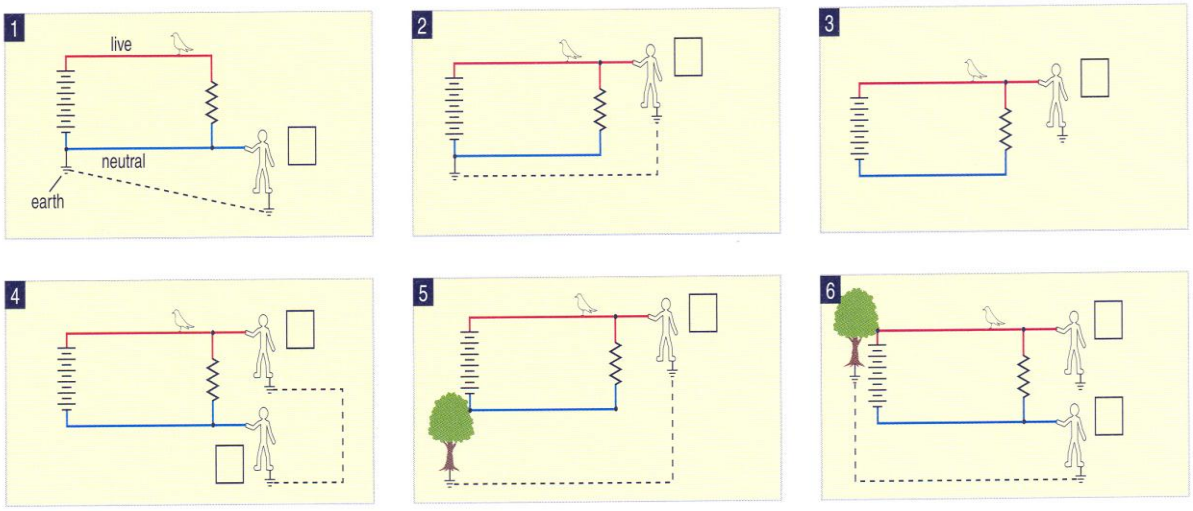
Task 3 ***What is what?***

ammeter, fuse, voltmeter, resistor, bulb, switch open/closed, battery, thermistor, LDR, variable resistor, incandescent lamp, diode



Safe electrical circuits

1 Test your knowledge of safe electrical circuits. Put a tick next to the people if they get electric shocks in these situations. Discuss the reasons why people get (or don't get) electric shocks.



1. *Read these captions. Write in the figure numbers of the diagrams they describe.*

a. Fig ☐ The person gets a shock because he touches the live wire in an earthed system.

b. Fig ☐ The person touches the neutral wire in an earthed system, and as a result he doesn't get a shock.

c. Fig ☐ As this system is not earthed, the person can touch any wire without a shock.

d. Fig ☐ This system is not earthed, but a tree touches the neutral wire and acts as an earth. The person touches the live wire. As a result, he gets a shock.

e. Fig ☐ There are no trees in contact, and so this system is completely unearthed. Because two people touch a wire, they both get a shock.

f. Fig ☐ In this non-earthed system, a tree touches the live and acts as an earth. Two people touch a wire. One touches the wire, and therefore gets a shock. The other touches the live wire. Therefore he is safe.

2. Electric quantities

Fill in the missing words:

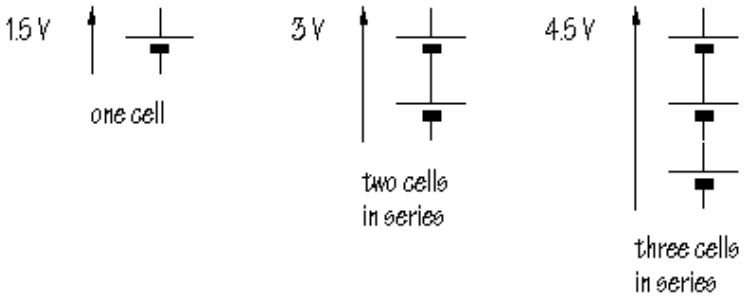
circuit, connected, current, glows, light, measured, provides, represented

Voltage

In the torch_____[1], what causes the current to flow? The answer is that the cells provide a 'push' which makes the _____ [2] flow round the circuit. When the cells are new, enough current flows to _____ [3] the lamp brightly. On the other hand, if the cells have been used for some time, they may be 'flat' and the lamp _____ [4] dimly or not at all.

Each cell _____ [5] a push, called its **potential difference**, or **voltage**. This is _____[6] by the symbol ***V***, and is _____ [7] in **volts**, **V**.

Typically, each cell provides 1.5 V. Two cells _____ [8] one after another, **in series**, provide 3 V, while three cells would provide 4.5 V:

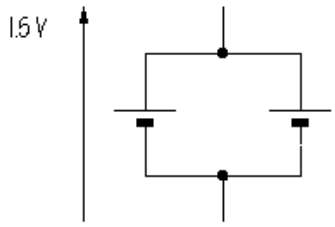


Cells connected in series

Translate the para' into good German.

Which arrangement would make the lamp glow most brightly? Lamps are designed to work with a particular voltage, but, other things being equal, the bigger the voltage, the brighter the lamp.

Strictly speaking, a **battery** consists of two or more cells. These can be connected in series, as is usual in a torch circuit, but it is also possible to connect the cells **in parallel**, like this



Label the components of the circuit.

Cells connected in parallel

Explain the underlined words.

A single cell can provide a little current for a long time, or a big current for a short time. Connecting the cells in series increases the voltage, but does not affect the useful life of the cells. On the other hand, if the cells are connected in parallel, the voltage stays at 1.5 V, but the life of the battery is doubled.

A torch lamp which uses 300 mA from C-size alkaline cells should operate for more than 20 hours before the cells are exhausted.

Resistance

What prevents the torch from flashing shortly and brightly due to large current for a short time?

If a thick copper wire was connected from the positive terminal of a battery directly to the negative terminal, you would get a very large current for a very short time. In a torch, this does not happen.

Part of the torch circuit limits, or *resists*, the flow of current. Most of the circuit consists of thick metal conductors which allow current to flow easily. These parts, including the spring, switch plates and lamp connections, have a low **resistance**. The lamp filament, on the other hand, is made up of very thin wire. It conducts much less easily than the rest of the circuit and has a higher resistance.

Why is there a vacuum in the torch head?

The flow of current through the filament causes it to heat up and glow white hot. In air, the filament would quickly oxidize. This is prevented by removing all the air inside the glass of the lamp and replacing it with a non-reactive gas.

The resistance, ***R*** , of the filament is measured in **ohms**.. If the battery voltage is 3 V (2 C-size cells in series) and the lamp current is 300 mA, 0.3 A, what is the resistance of the filament?

This is calculated from:

$$R = \frac{V}{I} = \frac{3}{0.3} = 10\ \Omega$$

Read the formula aloud.

where *R* is resistance, *V* is the voltage across the lamp, and *I* is current.

Mark the correct version of the homonyms.

In this case, 10 Ω is the resistance of the lamp filament once/ one's it has heated up. It's/ Its resistance is less when cold and their/ there will be a surge of/off current, more then/ than 300 mA, when the torch is first switched on.
Resistance values in electronic circuits very/ vary from a few/ view ohms, Ω , to values in **kilohms**, k Ω, (thousands of ohms) and **megohms**, M Ω, (millions of ohms). Electronic components designed to have particular resistance values are called **resistors.**

adapted from http://www.doctronics.co.uk/circuits.htm

3. Georg Simon Ohm and the electrical resistance

What happened in the following years?

1789	1833
1805	1839
1811	1841
1817	1843
1820	1850
1826	1854
1827	1881

Complete the sentences with the words given in the box.

thick	hot	less(2x)	faster	short	cold(2x)	long	more	thin	same

Electrons in _____(1) metal have higher energies than electron in _____ (2) metal.

They move _____ (3) and try to create an energy balance by streaming towards the _____ (4) end.

As _____(5) as there is a temperature difference current will flow.

More current flows through _____(6) wires than through _____ (7).

_____ (8) cables conduct _____(9)electricity than long ones.

An iron cable conducts _____(10) well than a copper cable of the _____(11) length and thickness.

If the resistance of a conductor is high _____(12) electricity is transported.

partner dictation **Current** Student A: *(you start)*

An electric current is _____. Inside a copper wire _____ .The electrons drift _____ until a current starts to flow. _____, electrons start to move in the same direction. _____ on the number of electrons passing per second.

_____ by the symbol I, _____ in amperes, or "amps", A. One ampere is _____ _____ past any point in a wire. _____ six million electrons passing per second. _____, but electrons are very small _____. In electronic circuits, _____ _____that is, thousandths of an amp.

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partner dictation **Current** Student B: (your partner starts)

_____ a flow of charged particles. _____ _____, current is carried by small negatively-charged particles, called electrons. _____ in random directions _____.When this happens, _____. The size of the current depends _____ _____.

Current is represented _____, and is measured _____. _____ a flow of 6.24 x 10^{18} electrons per second _____. That's more than _____ _____. This is a lot of electrons, _____ _____ and each carries a very tiny charge.

_____, currents are most often measured in milliamps, mA, _____.

Unit 3 Engineering materials

Which materials are used to make the things that you can find in your classroom?

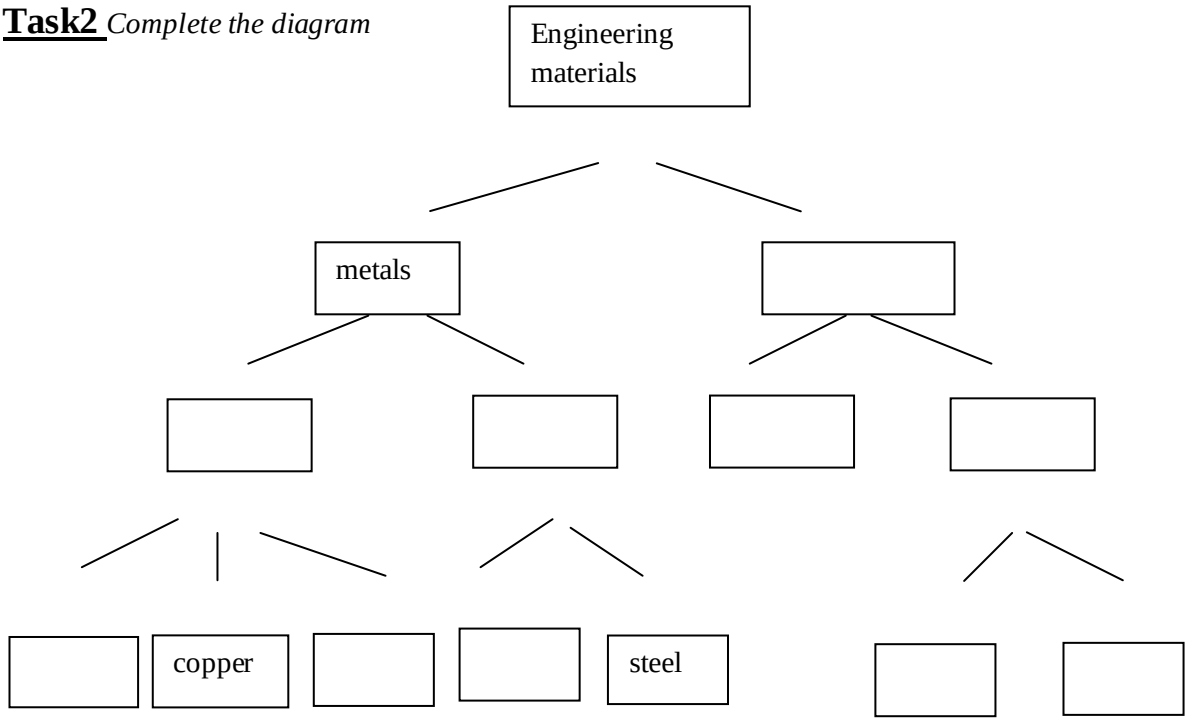
1.Classification of engineering materials

Task1 *Read the following text*.

Engineers have to know the best and most economical materials to use. Engineers must also understand the properties of these materials and how they can be worked. There are two kinds of materials used in engineering - metals and non-metals. We can divide metals into ferrous and non-ferrous metals. The former contain iron and the latter do not contain iron. Cast iron and steel, which are both alloys, or mixtures of iron and carbon, are the two most important ferrous metals. Steel contains a smaller proportion of carbon than cast iron contains. Certain elements can improve the properties of steel and are therefore added to it. For example, chromium may be included to resist corrosion and tungsten to increase hardness. Aluminium, copper, and the alloys, bronze and brass, are common non-ferrous metals.

Plastics and ceramics are non-metals; however, plastics may be machined like metals. Plastics are lighter and more corrosion-resistant. They can be softened and moulded into useful articles, e.g. medical aids. Plastics are classified into two types - thermoplastics and thermosets. Thermoplastics (e.g. ABS, Nylon, Acrylic) are tough, hard and durable. They can be shaped and reshaped by heat and pressure, but thermosets (e.g. epoxy resin) cannot be reshaped because they undergo chemical changes as they harden. Ceramics are often employed by engineers when materials which can withstand high temperatures are needed.

Task2 *Complete the diagram*



Task3 *Answer the following questions.*

a) What do you call a metallic composition with more than one element?
b) Why are certain elements added to a material?
c) What is the difference between thermoplastics and thermosets (thermosetting plastic)?
d) When are ceramics employed by engineers?
e) Which other verbs can you use to express "to work on a material"?

2. Properties of engineering materials

brittle - flammable - flexible - gaseous - hard - heavy - light(weight) - liquid - opaque - solid - rigid – soft - stiff - strong - transparent – weak – heat-resistant

Task 1 *Use some of these words to complete the following passage:*

Steel has been used for a long time for building vehicles because it is a very _____ *(not soft)* material. However, it corrodes quickly. That is why alloys are preferred that are more resistant to water and other substances.

Another metal that has been used for cars is aluminium. Because it is so _____ *(not heavy)* it reduces the car's energy consumption. What is more, aluminium does not corrode.

Car engines can also be improved if steel is replaced by ceramics. The material is ideal because it is _____ (*non-flammable*). On the other hand, it is _____ *(it breaks easily)* and parts to be used for the engine have to be carefully checked for impurities.

Many parts of modern cars are now made of plastics because they are cheap and easy to produce. But as they do not decompose they add to our waste problem.

Plastics can be made hard as stone, _____ (*not weak*) as steel, _____ (*clear*) as glass or _____ (*impenetrable to light*), light as wood, and _____(*not stiff*) as rubber. Plastics are also lightweight, waterproof, chemical resistant, and produced in almost any color. More than 50 families of plastics have been produced, and new types are currently under development.

Task 2 *Find words in the text which mean the following:*

a) to oxidize
b) not easily destroyed by high temperatures
c) substances a material should not contain
d) to change into chemically simpler substances

Task 3 *Match the phrases on the right with the explanations on the left.*

1. Copper is very malleable	a. since electricity cannot pass through
2. Rubber is elastic	b. allows electricity to pass through easily
3. Glass is durable	c. can be rolled, drawn into new shapes without breaking
4. Plastics are insulating	d. because it stretches under stress and regains its original shape when the stress is removed
5. A corrosive material	e. is a sticky substance used to join things together
6. A conducting material	f. is its ability to resist forces which try to change its shape
7. Ductile materials	g. because it can easily be rolled into a new shape
8. An adhesive	h. because it doesn't corrode
9. The hardness of a material	i. causes rust

Task 4 *Complete the following table. Use a dictionary if necessary.*

Adjective	Noun	Example material
malleable		copper
ductile		
strong	tensile _____	
durable		
elastic		
hard		
corrosion-resistant		
gaseous		
light		
soft		
rigid		
tough		
conducting		
flammable		

Malleability: it is easy to roll a malleable material into a new shape. A malleable material doesn't fracture easily under pressure. Gold is extremely malleable. It is possible to roll gold into very thin sheets. Copper is very malleable and so is lead. Glass is not at all malleable nor is cast iron. It is easy to fracture glass with a hammer. Cast iron also fractures easily.

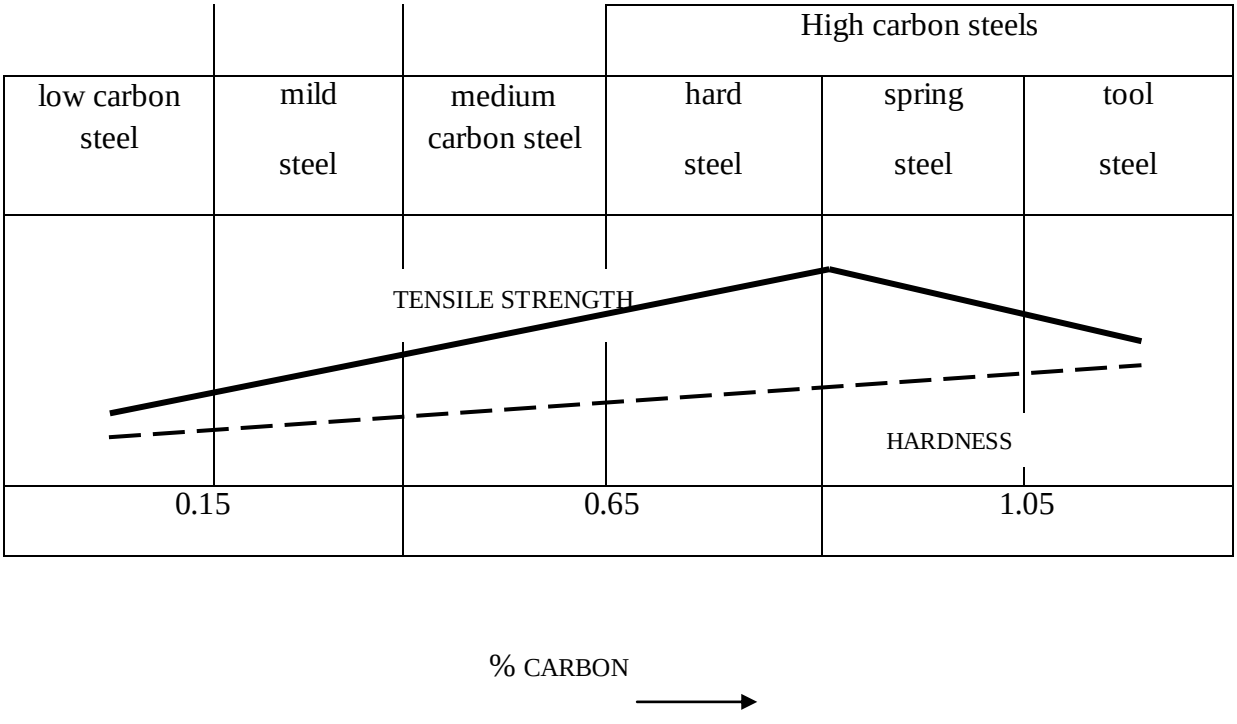
Ductility: it is easy to draw a ductile material. I does not fracture and it retains its new shape. Copper is extremely ductile. Tin is very ductile and so is aluminium. Steel is not very ductile and nor is lead. It is very difficult to draw lead into thin wire because it fractures easily.

Elasticity: an elastic material stretches easily under stress. However, remove the stress and it does not retain its new form. Some steels are quite elastic. Glass is not at all elastic nor is cast iron.

Durability: a durable material does not corrode easily. Under normal conditions glass is very durable and so are plastics. Among the metals chromium is extremely durable and so is platinum. Cast iron is not very durable and nor is steel.

Tensile strength and hardness

In engineering it is important to know the tensile strength and the hardness of different alloys. The table below compares the tensile strength, the hardness and the carbon content of some common steels.



Hardness: this is the ability to withstand abrasion.

Low carbon steel is not very hard. It is the softest of the steels. Mild steel is harder than low carbon steel. Medium carbon steel is even harder. The high carbon steels are the hardest. Hard steel is not as hard as spring steel. Tool steel is the hardest. Among these common steels, hardness is in proportion to their carbon content. The greater the carbon content, the greater their hardness.

Tensile strength: this is the ability to withstand tension.

Low carbon steel is not very strong. It is the weakest of the steels. Mid steel is stronger than low carbon steel. Medium carbon steel is even stronger. The high carbon steels are the strongest. However, their strength is not always in proportion to their carbon content. Some tool steels are not as strong as some hard steels. Below 0,85% carbon, the greater their carbon content, the stronger they are. Above 0,85% carbon, the greater the carbon content, the weaker they are.

Furthermore

Engineering materials can be:

soft, tough, stiff, brittle, robust, rigid, transparent, light-weight, opaque, gaseous, heavy, spongy, flammable, bendable, unbreakable, flexible, combustible, corrosion-resistant, wear-resistant, heat-resistant, scratch-resistant, fire-proof, water-proof, flame-proof

they can have:

poor corrosion resistance, high impact strength, low friction

engineering materials can:

withstand high temperatures, undergo chemical changes, fracture easily, retain their shape, regain their original shape

Which of the materials do you know? What are their properties/ their applications?

alloys, stainless steel, brass, tin, chromium, copper, clay, synthetic materials, lead, aluminium, biomaterials, metals, ceramics, glass, polyester resin, rubber, cement, wood, plastic, PVC

Task 5 *Complete the text below using the following verbs and adjectives*

brittle, conducting, durable, flame-proof, flammable, light, tough, stiff, transparent, volatile

Materials are chosen for specific physical and chemical properties that make them useful. For example, materials that are strong and _____ (their shape is not easy to change), such as wrought iron steel, are ideal for building solid constructions and supporting heavy loads.

Mountain climbers who must keep the weight of what they carry to a minimum, need items made of _____ (not heavy) materials, such as plastic or aluminium.

Sometimes, we search for materials that are _____ (not quickly changed) and _____ (long lasting), such as leather for shoes.

Whenever there is a risk of fire, _____ substances (that resist heat) such as asbestos come in useful.

Electricians could not do without a metal like copper, which is ideal for _____ heat and electricity (allowing them to pass through).

In many cases useful properties of materials are combined with disadvantages. Glass, which is ideal for making windows because it is _____ (you can see through it), has to be handled carefully because it is _____ (breakable). And although petrol is an excellent fuel since it is _____ (it burns easily) it is also dangerous to use as it is extremely _____ (it changes quickly into gas).

Task 6 *Make sentences using the words given.*

a. Elastic / material / stretch / easy / pressure

b. Tensile strength / steel / depend / carbon content

c. Properties / engineering materials / improve / add / certain elements

d. Chromium / use / make / steel / corrosion-resistant

e. Alloys / durable / pure metals

f. The/ carbon content/ is/ steel/ the/ harder/ it/ higher.

2.Reading and discussing

Task 1 *Read either text A or text B, sum up the main ideas of your text, and afterwards do the tasks which follow together with your partner.*

Text A - Metals

Why does man use metals still so much today when there are other materials, especially plastics, which are available? A material is generally used because it offers the required strength, and other properties, at minimum costs. Appearance is also an important factor. The main advantage of metals is their strength and toughness. Concrete may be cheaper and is often used in building, but even concrete depends on its core of steel for strength.

Plastics are lighter and more corrosion-resistant, but they are not usually as strong. Another problem with plastics is what to do with them after use. Metal objects can often be broken down and the metals recycled; plastics can only be dumped or burned.

Not all metals are strong, however. Copper and aluminium, for example, are both fairly weak - but if they are mixed together, the result is an alloy called aluminium bronze, which is much stronger than either pure copper or pure aluminium. Alloying is an important method of obtaining whatever special properties are required: strength, toughness, resistance to wear, magnetic properties, high electrical resistance or corrosion resistance.

The properties of a metal can be further improved by use of heat treatment. Heat treatment is the term given to a number of different procedures in which the properties of metals and alloys are changed. It usually consists of heating the metal or alloy to a selected temperature below its melting point and then cooling it at a certain rate to obtain those properties which are required. For example, hardening is used to make metals harder. Tempering makes them softer and less brittle. Annealing is carried out to make a metal soft so that it can be machined more easily. In this way, metallic materials can be produced to meet every kind of engineering specification and requirement.

True or false? *Correct the false statements.*

1. Concrete is a cheap building material.
2. Plastics are more easily recycled than metals
3. Aluminium bronze is an example of an alloy.
4. Pure copper is stronger than the alloys that are made by mixing copper with aluminium.
5. Tempering is a kind of heat treatment.
6. It is sometimes an advantage for a metal to be soft.

Text B – Titanium

Titanium is a silver-white metallic element used principally to make light, strong alloys. Titanium is one of the transition elements of the periodic table.

Titanium was discovered in 1791 in the mineral menachanite by the British clergyman William Gregor, who named the new element menachite. Four years later, the German chemist Martin Heinrich Klaproth rediscovered the element in the mineral rutile and named it titanium in allusion to the strength of the mythological Greek Titans. The metal was isolated in 1910.

Pure titanium is soluble in concentrated and insoluble in water. The metal is extremely brittle when cold, but is readily malleable and ductile at a low red heat. Titanium melts at about 1660° C, boils at about 3287° C. Titanium burns in oxygen at 610° C to form titanium dioxide, and it burns in nitrogen at 800° C to form titanium nitride.

Because of its strength and light weight, titanium is used in metallic alloys and as a substitute for aluminum. Alloyed with aluminum and vanadium, titanium is used in aircraft for fire walls, outer skin, landing-gear components, hydraulic tubing, and engine supports. The compressor blades, disks, and housings of jet engines are also made of titanium. A commercial jet transport uses between 318 and 1134 kg of the metal. Titanium is also widely used in missiles and space capsules; the Mercury, Gemini, and Apollo capsules were made largely of titanium. It is also used in heat exchangers in desalinization plants because of its ability to withstand saltwater corrosion. In metallurgy, titanium alloys are employed as deoxidizers and denitrogenizers to remove oxygen and nitrogen from molten

metals. Titanium dioxide, known as titanium white, is a brilliant white pigment used in paints, lacquers, plastics, paper, textiles, and rubber.

(adapted from: Microsoft ® Encarta ® Reference Library 2004)

a) **Sum up the main properties of titanium**.
b) **Find out how you pronounce the following words**: dioxide, nitride, nitrogen, hydraulic

Tempering, Annealing, Hardening

Task 3 *Find the missing words*

Tempering

It is a low-temperature _____ (cosrsep)[1] in the heat treatment of steel by which a desirable balance is obtained between the _____ (ndsrahes)[2] and toughness of the finished product. Reheating to a lower temperature _____ (easeecdrs)[3] the hardness and toughness is controlled by the _____ (rreetematup)[4] to which the steel is reheated and the duration of the heating.

Annealing

It is aprocess of heat treatment by_____ **(**ichwh)[5] glass and certain metals and alloysare rendered less brittle and more _____ (sttransie)[6] to fracture. Ferous metals and glass are annealed by heating and them to _____ (ghih)[7] temperatures and cooling them _____ (wsolly)[8]; copper and silver, however, are best annealed by heating and cooling them _____ (clkuqiy)[9]**,** then immersing in water.

Case Hardening

It is any of several processes for hardening the _____ (ascrefsu)[10] of steel products in order to make them more resistant to abrasion and wear, while leaving the interior soft and therefore _____ (ghoteru)[11] and more fracture-resistant.

Some elements have rather unknown trivial names in English. The chemical symbols and some characteristics will help you to find the appropriate match.

N Na Hg Pb W K H

element	symbol	state of matter at standard condition	"family"	properties
sodium		solid	alkali metal	soft, silvery white, highly reactive, boiling point 883°C
nitrogen		gaseous	gas	colourless, odourless, tasteless, 78.1% by volume of Earth's atmosphere
hydrogen		gaseous	gas	colourless, odourless, tasteless, highly flammable, diatomic
mercury		liquid	metal	poisonous, silverish colour
lead		solid	metal	very heavy, not very hard, grey, partly poisonous
tungsten		solid	metal	very hard, heavy, steel-grey to white, highest melting point of all the non-alloyed metals
potassium		solid	alkali metal	soft silvery-white metallic, very reactive, especially with water, first isolated from potash

Chemical elements - Periodic table of elements

Oxygen:

symbol: O, atomic number: 8, group: nonmetals

properties: odorless, tasteless, colourless, gaseous/ the element boils at -182.96° C, melts at -218.4° C

Choose 3 elements from the periodic table and write a similar description.

Reading Comprehension: *Read the text and do the tasks given below.*

Scientists discover ground-breaking material

Graphene, which was discovered at the University of Manchester in 2004, is a one-atom-thick crystal with unusual highly conductive properties, which has quickly become one of the hottest topics in physics and materials science. It is also tipped for a number of future applications in electronics and photonics. But research published (in January 2009) by Professor Andre Geim and Dr Kostya Novoselov, who led the group that discovered graphene in 2004, suggests its uses could be far greater.

That's because the scientists, from the University's School of Physics and Astronomy, have found that graphene will react with other substances to form new compounds with different properties - opening up further opportunities for development in the field of electronics.

As part of the research, published today in the leading scientific journal *Science*, Professor Geim and Dr Novoselov have used hydrogen to modify highly conductive graphene into a new two-dimensional crystal - **graphane.**

The addition of a hydrogen atom on each of the carbon atoms in the graphene achieved the new material without altering or damaging the distinctive one-atom-thick 'chicken wire' construction itself. But instead of being highly conductive, like graphene, the new substance graphane has insulating properties.

The researchers say the findings demonstrate that the material can be modified using chemistry - clearing the way for the discovery of further graphene-based chemical derivatives.

"Graphene is an excellent conductor and is tipped for many electronic applications," said Dr Novoselov. "However it was tempting to look at ways to gain additional control of its electronic properties through the use of chemistry. Our work proves that this is a viable route and hopefully will open the floodgates for other graphene-based chemical derivatives. This should widen the possible applications dramatically."

The unique electronic properties of graphene have already led researchers to look at ways the material could be used in the development of increasingly small and fast transistors. However, the absence of the energy gap in the electronic spectra forced scientists to use rather complex graphene-based structures like quantum point contacts and quantum dots for this purpose.

The discovery that graphene can be modified into new materials, fine tuning its electronic properties, has opened up the increasingly rich possibilities in the development of future electronic devices from this truly versatile material.

Professor Geim said: "The modern semiconductor industry makes use of the whole period table: from insulators to semiconductors to metals. But what if a single material is modified so that it covers the entire spectrum needed for electronic applications? Imagine a graphene wafer with all interconnects made from highly conductive, pristine graphene whereas other parts are modified chemically to become semiconductors and work as transistors."

The Manchester researchers produced high-quality crystals of graphane by exposing pristine graphene to atomic hydrogen. The approach shows a way of making many other ultra-thin crystalline materials based on graphene. Adapted From: www.physorg.com/news, 30 Jan 2009

Tasks:

1. What is the difference between graphene and graphane?
2. What can these two materials be used for?

How do you pronounce the following words and which descriptions belong to them?

a.derivative	1.fresh, clean, pure
b.hydrogen	2.having many uses
c.pristine	3.made of a clear transparent mineral
d.viable	4.copied from sth else/ to have sth as its source
e.versatile	5.possible, capable
f.crystalline	6.a chemical element

What does it mean: *to open the floodgates to/for sth or sb*?

3.Conductors, semiconductors, insulators and electron flow

Task 1 *Mark ten technical words in the next paragraph and explain them.*

The electrons of different types of atoms have different degrees of freedom to move around. With some types of materials, such as metals, the outermost electrons in the atoms are so loosely bound that they chaotically move in the space between the atoms of that material by nothing more than the influence of room-temperature heat energy. Because these virtually unbound electrons are free to leave their respective atoms and float around in the space between adjacent atoms, they are often called *free electrons*.

In other types of materials such as glass, the atoms' electrons have very little freedom to move around. While external forces such as physical rubbing can force some of these electrons to leave their respective atoms and transfer to the atoms of another material, they do not move between atoms within that material very easily.

This relative mobility of electrons within a material is known as electric *conductivity*. Conductivity is determined by the types of atoms in a material (the number of protons in each atom's nucleus, determining its chemical identity) and how the atoms are linked together with one another. Materials with high electron mobility (many free electrons) are called *conductors,* while materials with low electron mobility (few or no free electrons) are called *insulators.*

It must be understood that not all conductive materials have the same level of conductivity, and not all insulators are equally resistant to electron motion. For instance, silver is the best conductor in the

"conductors" list, offering easier passage for electrons than any other material cited. Dirty water and concrete are also listed as conductors, but these materials are substantially less conductive than any metal.

Physical dimension also impacts conductivity. For instance, if we take two strips of the same conductive material -- one thin and the other thick -- the thick strip will prove to be a better conductor than the thin for the same length. If we take another pair of strips -- this time both with the same thickness but one shorter than the other -- the shorter one will offer easier passage to electrons than the long one.

Task 2 *Add the missing halves of the words*.

If we want elec__ __ __ __ __**1)** to flow in a cer__ __ __ __**2)** direction to a certain pl__ __ __**3)**, we must provide t__ __**4)** proper path for th__ __**5)** to move. To facil__ __ __ __ __**6)** this, wires are ma__ __**7)** of highly conductive met__ __ __**8)** such as copper o__**9)** aluminum in a wide var__ __ __ __**10)** of sizes.

Remember th__ __**11)** electrons can flow on__ __**12)** when they have t__ __**13)** opportunity to move i__**14)** the space between t__ __**15)** atoms of a material. Th__ __**16)** means that there c__ __**17)** be electric current on__ __**18)** where there exists a conti__ __ __ __ __**19)** path of conductive mate__ __ __ __**20)** providing a conduit for elec__ __ __ __ __**21)** to travel through. T__ __**22)** continuous flow of elec__ __ __ __ __**23)** requires there be a__**24)** unbroken path to per__ __ __**25)** that flow. Since t__ __**26)** wire is made o__**27)** a conductive material, such a__**28)** copper, its constituent at__ __ __**29)** have many free elec__ __ __ __ __**30)** which can easily mo__ __**31)** through the wire.

Adapted from : http://www.allaboutcircuits.com

Semiconductors

Task 3 *Fill in the missing words:* employed, needed, crystals, depending, amounts, less, produce, in, substituted, purity, leaving, chemically, conduct, through,

Semiconductors are any of a class of crystalline solids intermediate in electrical conductivity between a conductor and an insulator. Such a material can be treated …… to transmit and control an electric current. Semiconductors are …… in the manufacture of various kinds of electronic devices, including diodes, transistors, and integrated circuits.
Semiconductor materials may be divided into two general groups: intrinsic and extrinsic. An intrinsic semiconductor exhibits a high degree of chemical……. Its conductivity is poor and largely

temperature-dependent. Some common intrinsic semiconductors are single…… of silicon, germanium, and gallium arsenide. Such materials may be converted into the technologically more important extrinsic semiconductors by addition of small …… of impurities. This process, known as doping, alters the electrical properties to …… much greater conductivity. For example, the atom of an intrinsic semiconductor such as elemental silicon has four electrons …… its outermost shell. These electrons attach the silicon atom to its neighbouring atoms and are not free to move …… the solid. Accordingly, pure silicon is a poor conductor. If phosphorus atoms with five outer electrons are …… as an impurity for some of the silicon atoms, the fifth electron is not …… for binding to adjacent atoms and is free to move through the solid. Other types of impurity atoms, such as boron, have one …… outer electron than does silicon. When they are substituted for some of the silicon atoms, each captures one electron from a neighbouring silicon atom, …… an empty space. Such a hole behaves like a freely moving particle with a positive charge. The presence of these holes increases the ability of the silicon to … electric current. An extrinsic semiconductor is commonly classified as n- or p-type, …… on whether the impurity has an excess of negative charge (n-type) or a deficiency of negative charge (p-type).
(from: 1994-2000 Encyclopædia Britannica, Inc.)

intrinsic semiconductor - Eigenhalbleiter

extrinsic semiconductor – Störstellenhalbleiter

Task4 *Find the words.*

Semiconductors have had a monumental impact on our _____(oicstye)**1**. You find semiconductors at the heart of _____(omcecsriorospr)**2** chips as well as transistors. Anything that's computerized or uses radio _____(veasw)**3** depends on semiconductors. Today, most semiconductor chips and transistors are _____(atrdeec)**4** with silicon. You can change the _____(vieauhbor)**5** of silicon and turn it into a conductor by doping it. In doping, you mix a small amount of an _____(riipytmu)**6** into the silicon crystal. A diode is the simplest possible semiconductor _____(ivdcee)**7**. A diode allows _____(rrtucne)**8** to flow in one direction but not the other.

4.Grammar

Defining relative clauses

An alloy is a metal **which / that** is formed by mixing other elements.

An engineer is someone **who / that** designs the way machines, bridges etc. are built.

The material **(which / that)** the engineers had chosen was too expensive.

Mr Stephen leads a team **whose** job it is to develop a new heat-resistant material.

Non-defining relative clauses

Alloys, **which** are used for a variety of purposes, are formed by mixing other metals or elements.

Professor Johnson, **who** I have always wanted to talk to about the topic of my diploma thesis, is to give a talk at our college next week.

Professor Johnson, **whose** research is well-known all over the country, will give a few lectures at our college next week.

Task1 *Complete the sentences using a relative pronoun if necessary.*

a. Materials _____ are strong and stiff are ideal for building solid constructions.
b. Mountain climbers, _____ must keep the weight of what they carry to a minimum, need items made of light materials.
c. Sometimes we search for materials _____ are durable and tough.
d. Electricians could not do without a metal like copper, _____ is ideal for conducting heat and electricity.
e. When designing new products it is important to choose materials _____ properties make them user-friendly and reliable.
f. Glass, _____ is ideal for making windows because it is transparent, has to be handled carefully because it is brittle.
g. The material _____ we need for manufacturing is difficult to produce.
h. The engineer _____ the company is looking for should be an expert in the field of material technology.

Task2 *Make relative clauses.*

e.g. Tom is a student of precision engineering. He is 24 years old.

Tom, who is 24 years old, is a student of precision engineering.

1. Steel is an elastic material. It is an alloy.
2. Low carbon steel is not very hard. It is used for making tins, wire, pipes.
3. A multimeter is a device. It is used for measuring voltage, current and resistance.
4. The company is situated in Munich. I want to apply there for an industrial placement.
5. After my apprenticeship I worked at an optician's shop for one year. I enjoyed the apprenticeship very much.
6. Mary is a close friend of mine. I work together with her.

Linking

Task3 ***Fill in the missing linkers****: in spite of, therefore, at the same time, although, however, for example, as a result, because/since, in fact, on the other hand*

1. Most alloys are a mixture of metals. ……, steel is a mixture of iron and carbon.
2. Magnesium and calcium are very active metals. ……., they are useless for construction purposes.
3. …..… iron (steel) is the most widely used metal, it rusts more easily than most other metals.
4. When a metal is connected in a circuit, outer electrons in the metal atoms move easily towards the positive terminal…… … electrons can be fed into the other end of the metal from the negative terminal.
5. …….. copper is very ductile, it can be drawn into wires of any diameter from about 0.025 mm upward.
6. …….. some plastics are made from plant oils, the majority are made from fossil fuels.
7. Thermoplastics can be repeatedly softened by heating and hardened by cooling. Thermosetting plastics,…. …, harden permanently after being heated once.
8. Since the arrival of the laser in the 1960s it has provided the stimulus to make optics one of the most rapidly growing fields in science and technology today. ……., by the mid-1990s lasers had given rise to a dramatic new field in technology called photonics.
9. Lasers are used to 'weld' pieces of materials together…… …, if the retina in a person's eye becomes loose, a laser is used to 'weld' it back on.
10. If you measure the surface area of the walls, you'll see that buildings with an irregular shape have a greater surface area…… …, more materials will be required.
11. …….. strict safety regulations, accidents sometimes occur.
12. I thought the work would be difficult…… …, it's quite easy.

Expressing reason and consequence

cause lead to, result in, cause, generate, produce, provoke, bring about, create, develop **[effect]**

effect result from, stem from, originate from, derive from, (passive v.) is created by [**cause**]

or with connectives

introducing **cause**: due to , as a result of, since, because, in response to, as

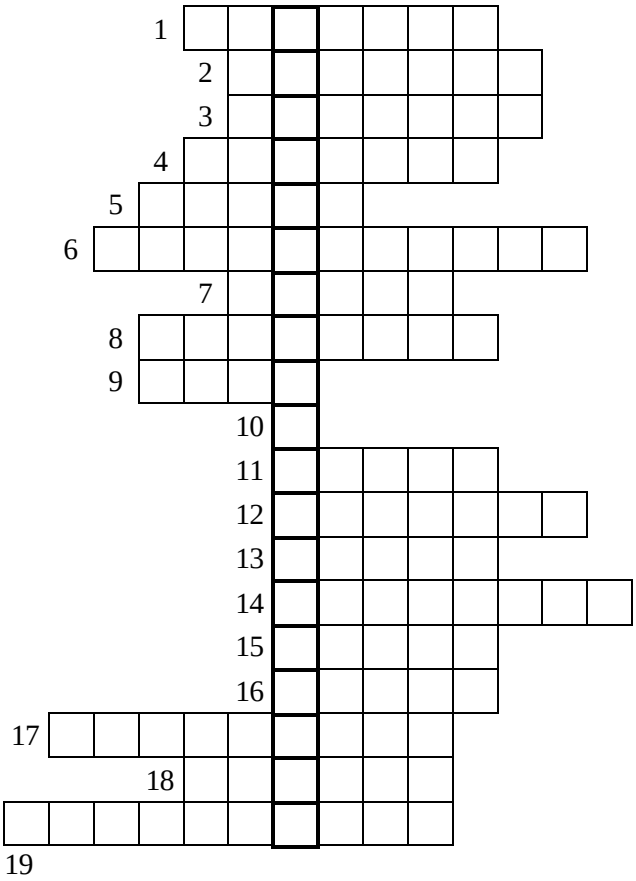
introducing **effect**: with the result that, so that, thus, therefore, consequently, hence, for this reason, thereby

Task 4 *Think of possible effects of the following issues: Could you even think of a chain of possible events?*

- The switch of the circuit is closed …
- Copper is heated to over 100 °C …..
- Pure semiconductors are doped ….
- Many free electrons in an atom …..
- Insulators do not allow current to flow because …

5.Revision

Task 1 *Which properties are described?*



Definitions:

down: able to remain unchanged or undamaged by rust or other chemical substances

across:

1. (of a metal) that can be beaten, pressed, rolled, etc., into a new shape
2. allows electricity to pass through (verb)
3. hard but easily broken
4. long-lasting
5. a mixture of metals, or of a metal and non metal
6. allows light to shine through
7. the opposite of heavy
8. speed
9. the opposite of thick
10. hyphen
11. not flexible, stiff
12. able to spring back into shape after being stretched or bent
13. retaining its shape, distinct from liquid and gas
14. state of being dirty (noun)
15. a ferrous material
16. impact-resistant
17. (esp. of metals) able to be pressed or pulled into shape without needing to be heated
18. kind of heat treatment
19. electricity cannot pass through

Task 2 *Find the missing words.*

1. Cast iron and steel are _____ , a mixture of iron and _____ .
2. Certain elements can improve the **p**_____ of steel.
3. You add chromium to make steel more _____- _____ and tungsten to increase hardness.
4. Plastics and **c**_____ are non- _____.
5. Thermoplastics can be shaped by **h** ____ and **p**_____-.
6. Aluminium does not **c**_____.
7. Copper is very **m**_____.
8. Glass is **d**_____ .
9. Rubber is an _____ material.
10. The main advantages of metals are their **st**_____ and **t**_____.
11. Plastics are **l**_____ and can be machined easily.
12. The properties of metals can be improved by **h**_____ **t**_____.
13. The relative mobility of electron within a material is called **c**_____.
14. Materials with many free electrons are _____, e.g, _____, _____, _____.
15. Materials with low electron mobility are called _____, e.g. _____, _____ , _____ .
16. Semiconductors are largely **t**_____ - dependent.
17. The addition of small amounts of **im**_____ is called _____ .

Unit 4 Laboratories, experiments and safety

1.History of science

Task 1 *Watch the video about Galileo Galilei and answer the following questions.*

Group 1

1. What was the time of the Renaissance like?
2. What role did he play at his time?
3. What kind of experiments did he carry out to show acceleration and gravity?

Group 2

1. What were the ideas taught at the universities of that time based on and what was the problem with them?
2. Originally, Galileo Galilei wanted to become a monk, but what did he study then?
3. What kind of student was he?

Group 3

1. What did he prove or disprove?
2. When/where was the result of the gravity experiment proved?
3. When did he hear about an instrument similar to a telescope and who had invented it?

Task 2 *Choose the correct answer.*

It seems entirely (**1**) … to us that there are teams of scientists in universities and other institution around the world, attempting to (**2**) … the way the world works. However, it hasn´t always been that (**3**) … . Although the scientific method is now about five hundred years old, the ancient Greeks, for example, believed that they could work out the (**4**) … of natural events just by the power of thought.
During the 17th century, more and more people began to realise that they could (**5**) … their scientific ideas by designing a relevant (**6**) … and seeing what happened. A lot of (**7**) … was made in this way by individual scientists. These men and women often worked alone, carrying out (**8**) … into many different areas of science, and they often received very little (**9**) … for their hard work. At the start of the 20th century, though, it became (**10**) … that science was becoming more complicated and more expensive. The individual scientist disappeared, to be replaced by highly qualified teams of experts. Modern science was born.

1 physical, natural, typical real
2 create, invent, construct, discover
3 route, method, way, technique
4 aims, reasons, causes, impulses
5 calculate, estimate, measure, test
6 experiment, research, attempt, analysis
7 development, movement, progress, evolution
8 research, experiment, discovery, education
9 award, prize, gift, reward
10 clear, true, accurate, actual

(taken from: Destination Grammar &Vocabulary)

2.Laboratories

Task 1 *Answer the following questions*

1. What can you find in the laboratory?
2. What does a workplace look like?
3. Explain the underlined words in English.

"Dear guests,

Now we'll take a short tour of the laboratories at the university. We're especially proud of them. At the moment, we have more than twenty well-equipped labs, where our students gain practical experience and where they prepare for their future work in industry.

First, let's have a look at one of the electrical engineering labs. This way, please.

This lab is set up for sixteen students and divided into eight equally equipped work stations.

In fact, we're gathered around one of the work stations right now. On the right-hand side, there's a container. In the upper drawer of the container, we store switches and bridges. Students use them to connect the elements of an electrical circuit. The plug-in board needed for this kind of experiment is located above the container.

The device to the left of the plug-in board is a 20 MHz dual channel oscilloscope. It's an instrument that shows variations in current as a wavy line on the screen of a cathode ray tube, which is like a TV screen. On the right of the plug-in board there are a capacitor, a coil, and a resistor, all of which are metrically adjustable. Next to them there's a big stop-watch used for measuring time. For example, students often need to find out how long a certain capacitor takes to charge up.

Directly at eye-level the mains supply circuit has been installed. Of course, the work station is also equipped with the necessary sockets. Cords and plugs are attached at the sides.

Finally, let's have a look at the devices on the desk itself. This here is a slide resistor and that's a multimeter used for measuring different aspects of an electric circuit such as voltage, resistance, and

current. The transformer is also used frequently. It's an apparatus that increases or decreases the voltage of an electric power supply.

If you look around you'll notice that the room is furnished with several boards and chairs as well as, of course, a special work station for the supervising lecturer, including a PC."

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If you look around you'll notice that the room is furnished with several boards and chairs as well as, of course, a special work station for the supervising lecturer, including a PC."

Task 2 *Read the text about the laboratory of electrical engineering and underline all expressions describing location.*

Fill in suitable prepositions

1. The laboratory is ... the lift.
2. Since the main entrance was closed we had to get inside ... the back door.
3. During the lecture the professor stands ... the students.
4. There's a printer ... the scanner and the screen.
5. There are a lot of books ... the professor's desk.
6. You can find an overhead projector ... each seminar room.

Task 3 *Describe one laboratory that you use during your studies. (give a short presentation)*

A cathode-ray oscilloscope

Task 4 *Explain the underlined words to your neighbor and ask him/ her for the words missing in your text.*

Student A

A cathode-ray oscilloscope is an electronic display device containing a cathode-ray tube (CRT), used to produce _____ patterns that are the graphical representations of electrical signals. The graphs plot the relationships between two or more variables, with the horizontal axis normally being a function of time and the vertical axis usually a function of the _____ generated by the input signal to the oscilloscope.
Because almost any physical phenomenon can be converted into a corresponding electric voltage, with the use of a transducer, the oscilloscope is a versatile tool in all forms of physical _____. The German physicist Ferdinand Braun developed the first cathode-ray oscilloscope in 1897. Speed of

response is the cathode-ray oscilloscope's chief advantage over other plotting devices. General-purpose oscilloscopes have plotting frequencies of up to 100 megahertz (MHz). Response times as rapid as 2,000 MHz are achievable with special-purpose, high-speed oscilloscopes. The central _____ in this device, the cathode-ray tube, consists of an evacuated glass container with a phosphorescent
coating at one end (similar to that of a television screen) and an electron gun and a system for focusing
and deflecting the beam of electrons at the other. The electron beam emerging from the electron gun passes between pairs of metal _____ mounted in such a way that they deflect the beam horizontally and vertically to control the production of a luminous pattern on the screen. The screen image is a visual representation of the voltages applied to the deflection plates.
Alternatively, the beam may be deflected magnetically by varying the currents through externally mounted deflection _____. Thus, almost any graph can be plotted on the screen by generating horizontal and vertical deflection voltages or currents proportional to the lengths, velocities, or other quantities being observed.
The cathode-ray oscilloscope is one of the most _____ used test instruments; its commercial, engineering and scientific applications include acoustic research, television-production engineering, and electronics design.

Student B

A cathode-ray oscilloscope is an electronic _____device containing a cathode-ray tube (CRT), used to produce visible patterns that are the graphical representations of electrical signals. The graphs plot the relationships between two or more _____, with the horizontal axis normally being a function of time and the vertical axis usually a function of the voltage generated by the input signal to the oscilloscope.
Because almost any physical phenomenon can be _____ into a corresponding electric voltage, with the use of a transducer, the oscilloscope is a versatile tool in all forms of physical investigation. The
German physicist Ferdinand Braun developed the first cathode-ray oscilloscope in 1897. _____ of response is the cathode-ray oscilloscope's chief advantage over other plotting devices. General-purpose oscilloscopes have plotting frequencies of up to 100 megahertz (MHz). Response times as rapid as 2,000 MHz are achievable with special-purpose, high-speed oscilloscopes. The central component in this device, the cathode-ray tube, consists of an evacuated glass container with a phosphorescent coating at one end (similar to that of a television screen) and an electron _____ and a system for focusing and deflecting the beam of electrons at the other. The electron beam emerging from the electron gun passes between pairs of metal plates mounted in such a way that they deflect the beam horizontally and vertically to control the production of a luminous pattern on the screen. The screen image is a visual representation of the voltages applied to the deflection plates.
Alternatively, the beam may be deflected magnetically by varying the _____ through externally mounted deflection coils. Thus, almost any graph can be plotted on the screen by generating horizontal and vertical deflection voltages or currents proportional to the _____, velocities, or other quantities being observed.
The cathode-ray oscilloscope is one of the most widely used test instruments; its commercial, engineering, and scientific applications include acoustic _____, television-production engineering, and electronics design.

Answer the following questions:
a) What is an oscilloscope used for and where is it applied?
b) When was the first one developed?
c) What is the main advantage of this device?
d) What does a cathode-ray tube consist of and how does it work?
e) How are the graphs plotted on the screen?

Task 5 *Read the following guidelines for laboratory sessions in physics at Exeter University.*

a) Match each paragraph with the appropriate headline.

Assignments, Feedback, Content, Duration, Assessment, Intended learning outcome

b) Compare the guidelines with those that apply to your lab sessions.
c) Make sure you understand and remember the vocabulary printed in italics.

Experiment is one of the central activities of a scientist. *Experimental observations* form the basis for new *hypotheses*, and also test *scientific theories*. It is therefore essential that all physicists understand the experimental method and develop the ability to *make reliable measurements*. This module provides a broad foundation in experimental physics.

.....

During this module, students will develop the following subject-specific skills:

planning and execution of experimental investigations

accurate and thorough *record keeping*

critical *analysis* and discussion of results, including the use of computers for data analysis

minimisation of experimental errors

.....

Students are provided with a Laboratory Manual in which the experiments for this module are summarised. There is some choice of which experiments are undertaken. The range of experimental topics include experiments in optics, electromagnetism, mechanics and nuclear physics.

Students work in pairs. Before tackling the experiment students study the worksheet and necessary literature, discuss the underlying physics and plan the experiment. Experimental work commences after the student has proved to the demonstrator in the initial discussion that they have a fair grasp of the background of the experiment and knows how to undertake it. The experiment is completed by the student writing a *report* and the demonstrator *marking* the work in the final discussion with the student.

.....

Students are required to *attend the laboratory* for one 3-hour sessions each week. In addition to the sessions in the laboratory, students are expected to spend a roughly equal amount of their own time writing up experiments.

…….....

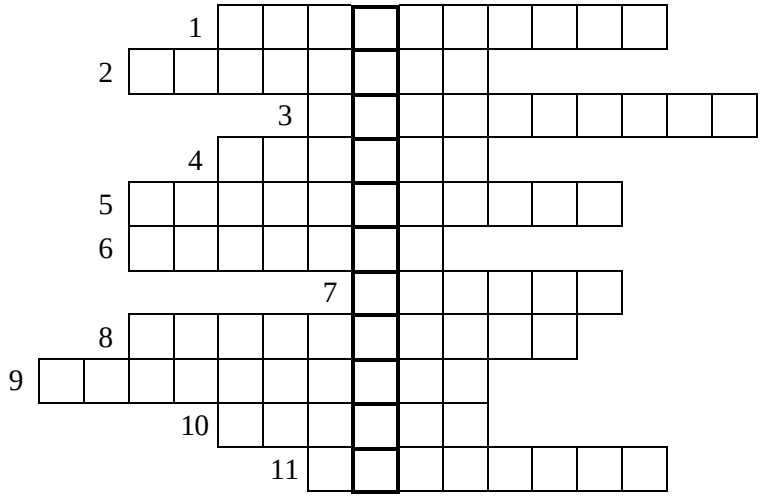
Experiments, written up in laboratory notebooks (75%); one group oral presentation (8%); one formal report (17%)

……

Experiments are marked by a demonstrator, during a 15-minute marking session with each student. Marks are given for general layout, demonstration of good experimental technique, analysis of the results and *conclusions* drawn.

All the marks, after moderation are added and a percentage derived which contributes to the overall physics mark obtained in the sessional examination. The pass mark for the laboratory module is 40%. Any student who fails to reach this minimum standard will not be permitted to sit the sessional examination.

Word Puzzle *You may take the text above as a help.*



Definitions:

down: the act of watching sth carefully for a period of time

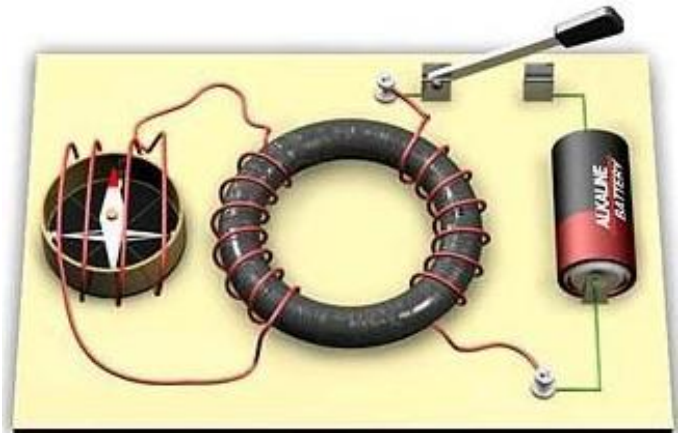
across:

1 an idea of sth that is based on a few known facts but hasn't been proved yet (pl)
2 that can be trusted (adj)
3 a task that is given to you, usually as part of your studies
4 evaluate
5 act of finding the size, quantity etc. of sth
6 verb that refers to *the definition down*
7 to go to a seminar
8 methodical
9 after having certain results you may draw a ....
10 piece of work you have to write for your lab session
11 the examination of something in order to understand it better

3. Experiments

Task 1 *Read the report: Faraday's Magnetic Field Induction Experiment*

In 1831, Michael Faraday made his discovery of electromagnetic induction with an experiment using two coils of wire wound around opposite sides of a ring of soft iron similar to the experiment setup below.



When you close a switch, a current passes through the first coil and the iron ring becomes magnetized. Note that the compass in the second coil deflects momentarily and returns immediately to its original position. The deflection of the compass is an indication that an electromotive force was induced causing current to flow momentarily in the second coil. When you open the switch, notice that the compass again deflects momentarily, but in the opposite direction.

The closing and opening of the switch cause the magnetic field in the ring to change: to expand and collapse respectively. Faraday discovered that changes in a magnetic field can induce an electromotive force and current in a nearby circuit. The generation of an electromotive force and current by a changing magnetic field is called electromagnetic induction.

Task 2 *Imagine you have just done the experiment. Write a short report using the following outline:*

1. Purpose of the experiment
2. Equipment
3. Procedure
4. Observation
5. Conclusion

Useful expressions:

The aim of the experiment was ...
First/at first/ at the beginning ...
After that/then/next ...
Finally/At the end/To finish ...

Reports of experiments are usually written using the *past forms* of the verbs.
Passive forms are very frequent.

Task 3 *Complete the table.*

PASSIVE	**Simple**	**Continuous**
Present	it is repaired	
Past		
Future		
Present Perfect		
Past Perfect		
Future Perfect		

Task 4 *Use the structures above to complete the sentences*

1) People are using computers in all kinds of work. Computers ....
2) He company has patented the process.
3) Charles Townes produced the first laser in 1960.
4) You have to keep dangerous chemical in a safe place.
5) You shouldn´t have left the laboratory unlocked.
6) They will only sell the concentrate to bottling companies.
7) We are unlikely to discover intelligent life on other planets.
8) You can only see these particles through a microscope.

Task 5 *Watch, listen and complete.*

Great moments in science and technology: **Michael Faraday**

Faraday's first important discovery: the principle of _____

▼ ▼

Faraday's next question: Is it possible to _____?

▼ ▼

Faraday's findings: a short surge of _____in the second coil

→

_____ was transferred

▼ ▼

Faraday's next question: _____?

▼ ▼

Faraday's findings: electric current in one wire can only be transferred when _____

▼ ▼

Faraday's next question: _____?

▼ ▼

Result the invention of _____

- Which other important inventions and discoveries were made by Faraday?
- What was special about Faraday's scientific work?

Task 6 *Do you remember the equipment of the physics lab*? *Write down all devices and instruments that you know.*

Which experiments have you carried out so far?

Describe an experiment that you carried out during your lab session or at school. Include purpose, equipment, procedure, observation, conclusion.

Here are some verbs to help you:

-fix, adjust, turn, set, press, swing
-switch on/off
-watch, identify, calculate, observe, determine, measure

For example: **Viscosity**

Task 7 *Fill in the missing words.*

There are many ways to _____(suermae)**1** viscosity. One of the oldest and _____(ieasest)**2** ways is to see how fast a sphere falls through a fluid. The _____(teasfr)**3** the sphere falls, the _____(wlroe)**4** the viscosity. This makes sense: if the fluid has a high viscosity it strongly _____(isestsr)**5** flow, so the sphere falls slowly. If the fluid has a low viscosity, it offers _____(sesl)**6** resistance to flow, so the ball falls faster. The measurement involves _____(mniegrdenit)**7** the velocity of the falling sphere. This is accomplished by dropping each sphere through a measured _____(asnidcte)**8** of fluid and measuring how long it _____ (aktse)**9** to cover the distance.

Other experiments

Task 8 *Read the following short descriptions and find out the purpose of the experiments (a-d)*

Let a compass settle in a North-South direction. Then, with the circuit shown, hold the wire over the compass and press the switch (for a few seconds only). What happens to the compass needle when the current flows?

Rub a balloon on your clothes and then put it on the wall or ceiling so that it stays there.

Use a raybox (or a slide projector) with a narrow slit. Shine a ray of white light through a glass prism and on to a white screen. It seems that white light is really a mixture of several colours and can be split up by a prism.

Connect a single cell in series with a 6V lamp and a suitable ammeter. Note the ammeter reading. Connect another cell in series to assist the first cell. What happens to the ammeter reading? Use a third cell to increase the potential difference again.

What do you notice about the current as you increase the potential difference?

a) electrostatic induction
b) Oersted's experiment
c) Ohm's experiment (Ohm's Law)
d) Newton's experiment

Task 9 *Write the conclusions. Complete the following sentences.*

Use: proportional, carrying, electrons, induced, dispersed, flowing, repels, attracted

1. We find that a wire … a current has a magnetic field around it.
2. The current … through a metal wire is … to the potential difference across it (providing the temperature remains constant).
3. This happens because the negative charge on the rubbed balloon … some of the … in the ceiling away from the surface. This leaves the surface positively charged and so the negative balloon is … to the ceiling. The separated charges in the ceiling are called … charges.
4. The white light from the raybox has been … by the prism to form a visible spectrum. The colours, in order, are ….

A name you should remember

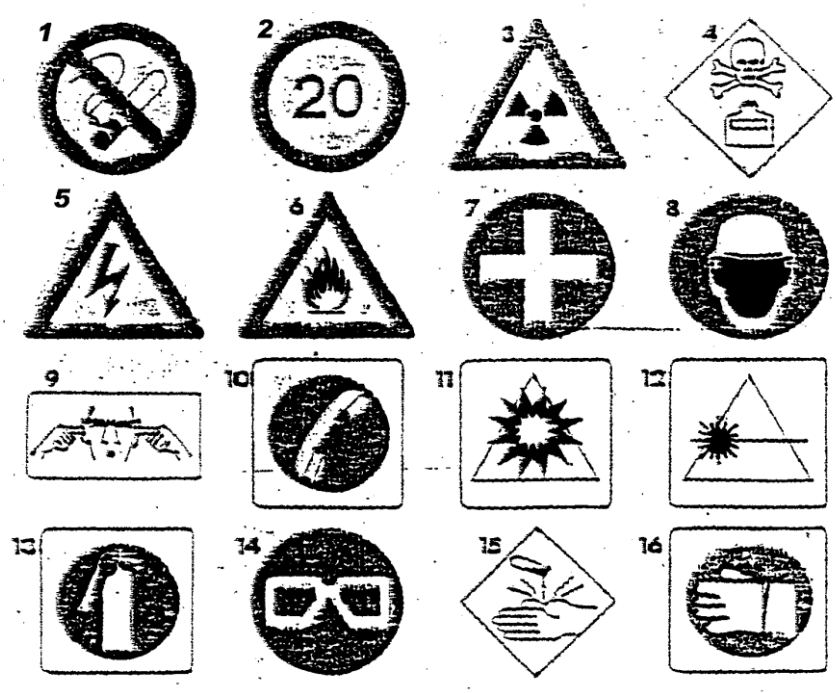
As long as you may live

The colours of the spectrum

Are known by **ROY. G. BIV**

4. Safety

Task 1 *Explain the meaning of the following signs?*



Task 2 *Listen and fill in the gaps*

A noisy environment

"OK, so let's look round the factory now. It's quite a (1) _____ environment so you need to take care. By the way you should (2) _____ when we go down to the factory. It's not (3) _____ but some of the machines are a bit noisy."

Warning signs

"This is the machine hall. Do you (4) _____ over there - the red circle with a (5) _____ line through it? It means you (6) _____ here. A blue circle shows something is (7) _____ - so that sign over there means you must (8) _____ in that area to protect your eyes. The yellow (9) _____ with the black border over there is a warning sign. It means the floor (10) _____."

Hazards

"Mind out. Don't get (11) _____. It's very hot. We don't want to burn yourself. And please (12) _____ when you walk across the floor. It (13) _____."

"So, if you follow me into the Finished Goods Area now … (14) _____ when you go past the packing area. Someone has left some (15) _____ on the floor. And be careful when you walk across (16) _____. There might be a fork-lift truck (17) _____ into the storage area.

Task 3 *Match the two parts of the sentences.*

1	Always wear ear protection	a	check electrical installations regularly.
2	Don't leave	b	emergency exits clear.
3	Keep	c	a machine without checking the safety procedures first.
4	Never place	d	when using a pneumatic drill.
5	Make sure you	e	bottles of chemicals carefully.
6	Check that	f	a ladder near an electricity line.
7	Do not operate	g	tools lying on the floor.
8	Label	h	the safety guard is in place.

Modals

Task 4 *What do the modals express? Match the corresponding parts.*

1. must	a. strong prohibition
2. should	b. strong obligation
3. may	c. advice
4. mustn't	d. Possibility

Task 5 *Complete with must - mustn't - should - may?*

1. You _____ always use technical devices in accordance with the safety regulations.
2. You _____ be aware of the danger of shock when working with high voltages.
3. Whenever there is a risk of shock, you _____ work alone.
4. You _____ always be careful. There _____ be unexpected voltages.
5. You _____ be particularly careful when measuring HF circuits.
6. You _____ use the multimeter in wet places.

Task 6 *Rewrite the following precautions using the phrases in the box to add emphasis.*

~~at all times~~ / every single / it's crucial / it's essential / it's vital / under no circumstances

1. The fire exit should always kept clear.
   The fire exit should be kept clear at all times.
2. It's important to test that the circuit is isolated.
   _____.
3. You should set the alarm routinely when you start the system.
   _____
4. It's a good idea to check that the cable is not damaged.
   _____
5. It's recommended that you should only store non-flammable materials in this zone.
   _____
6. Nobody should enter the restricted area without permission.
   _____
7. Before pressurising the system, make sure all the connections are tight.
   _____

Task 7 *What is going wrong here? – Which safety rules are not obeyed?*

Task 8 *Express the following safety regulations in English.*

1. Bei Versuchen unter elektrischen Spannungen müssen mindestens zwei Personen anwesend sein.
2. Es ist unzulässig, ohne ausdrückliche Genehmigung Geräte zu öffnen. Vor Arbeiten an offenen Geräten Netzstecker ziehen. Beachten Sie, dass Kondensatoren Restladungen haben können.
3. Eine Versuchsanordnung darf erst eingeschaltet werden, wenn der Aufbau von einer Aufsichtsperson überprüft wurde.
4. Spannungsführende Anlagenteile dürfen nicht berührt werden. Höhere Spannungen als 42 Volt können bereits lebensgefährlich sein.
5. Bei Arbeiten an Anlagen stets auf trockenem und gut isoliertem Boden stehen. Niemals mit feuchten Händen an elektrischen Anlagen hantieren oder messen.
6. Beim Arbeiten mit Chemikalien ist auf unbedingte Sauberkeit zu achten. Gegebenenfalls ist Schutzkleidung zu tragen (Schutzbrille, Schutzhandschuhe usw.)

Task 9 *Speak about your laboratory sessions on the basis of the following outline:*

How are the lab sessions organized? (Timing, number of sessions, where, what, individually, group work, ...)

1. How do you prepare for the sessions?
2. Describe a typical session.
3. Speak about follow-up activities and assessment.
4. Speak about the essential safety regulations.

Useful phrases for signposting your talk.

The topic of my talk is ...

I have divided my presentation into ... parts.

First of all ... then ... next ... after that ... finally ...

I'll be happy to answer your questions at the end of my talk.

Let me start by ...

That's all I have to say about .../ So much for ...

Let me turn to .../ Let's move on to ...

Let me summarize briefly what I've said./ If I can just sum up the main points ...

That concludes my presentation. Thank you for your attention. If there are any questions, feel free to ask.

Great moments in science and technology - Isaac Newton and Gravitation

A. Theories on planets and their movements

Greek philosophers
6th century BC:
Later:

Nicolas Copernicus:

Johannes Kepler:

William Gilbert:

René Descartes:

B. Newton's early years

Born on _____ in _____

Grew up on_____

He liked to _____

His uncle helped to send him _____

Lodged in a family of an apothecary and learned _____

At the age of 18 _____

C. Newton's findings

3 laws of mechanics were published _____

1st law:

A body at rest will remain at rest unless acted upon by _____ forces and the moving body will continue to move at the same _____ and in the same _____

2nd law:

a force acting on a body will give us an acceleration _____ that force and in the same direction as the force. The formula is: _____

3rd law:

relates to action and reaction – if one body _____ a force on another, the latter will impart an equal and _____ force to the former.

It is this reactive force that brings the ball to a halt and makes a boat glide back.

Conclusion: Bodies moved because _____

D. Law of Gravity

E.

- Why doesn't the moon crash into the earth?
- What does the law of gravity enable to explain?

F. More examples of Newton's findings

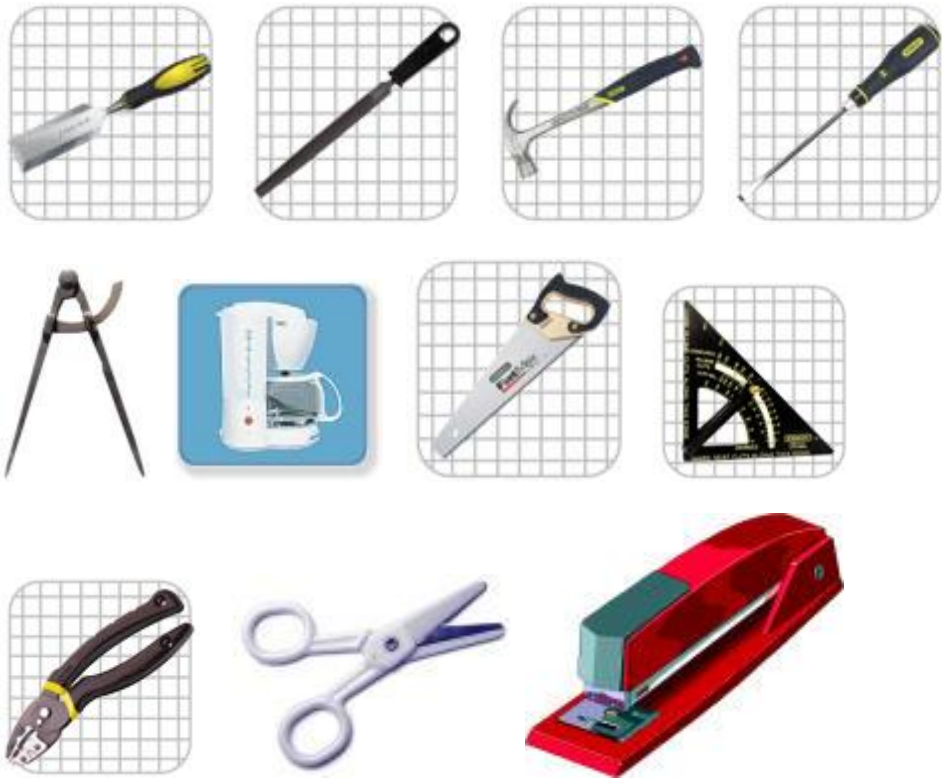
G.Last years

Unit 5 Instruments and tools

Task 1 *Have a look around. Are there any tools next to you? Can you name them? Describe briefly what you use them for?*

Have a look at the following pictures. Which tools/ devices do you use very often/ rarely/ never? Match the words with the pictures.

nail hammer, file, coffee machine, stapler, scissors, chisel, pair of compasses, screwdriver, saw, pliers, set square

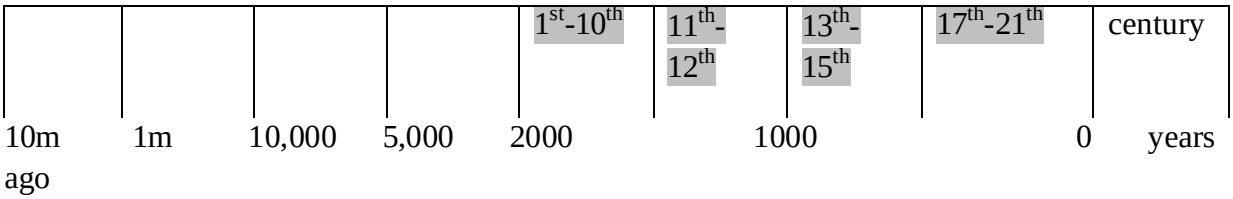


Tool -

an instrument for making material changes on other objects, as by cutting, shearing, striking, rubbing, grinding, squeezing, measuring, or other process. A hand tool is a small manual instrument traditionally operated by the muscular strength of the user; a machine tool is a power driven mechanism used to cut, shape, or form materials such as wood and metal. Tools are the primary means by which human beings control and manipulate their physical environment.

Task 2 *Read this magazine article and mark the inventions on the timeline.*

Note: a century ends in its own number. The 14th century is 1301-1400



Tools through the ages

The first knives were made about two and a half million years ago. They were crafted by early ancestors of modern humans. At first, sharp pieces f stone were broken off a rock, but in later times they were sharpened and straightened into blades.

The abacus is one of the first mechanical counting devices, an ancestor of today´s computers.

It consisted of a frame containing beads on wires. The modern abacus was designed by the Chinese around the year 1200

The compass allowed sailors to navigate across oceans and discover new worlds. The compass was invented by the Chinese about 2200 years ago. A spoon- shaped piece of magnetic rock was balanced on a flat surface. Since it was magnetic, the handle rotated to align itself with the earth´s magnetic poles.

The first mass- produced pencils were made in Germany in 1662, which helped writing and education to develop.

The harness lets people control horses and attach them to carts. It was probably invented about 6000 years ago, when horses were first tamed and kept.

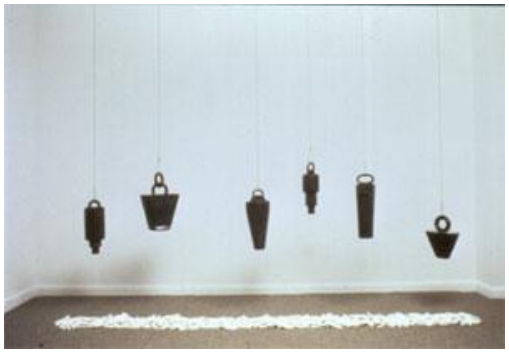
The scythe allows people to cut grass and harvest crops from the field. It consists of a long wooden shaft with handles on the end and in the middle, and a long curved blade on the other end. The blade is sharp on the inside. It was first used in Europe in the 12thcentury.

Glasses (or spectacles) make workers more productive and accurate, and allow people to work into old age. Mathematical calculations for spherical lens were first made by Arab scientists in the 11th century. The first spectacles were manufactured by Italian craftsmen in the 13th century.

Saws were first used by Egyptians more than 5000 years ago to cut both wood and stone. They were made of copper.

The first balance scales were seen in southern Mesopotamia about 9000 years ago. They consisted of two weighing pans attached to either end of beam, which was balanced on a central pivot. They allowed merchants to calculate the exact weight of goods.

The chisel consists of a long, narrow, sharpened edge attached to a handle. It´s different from a knife or axe, because it is driven by a sharp blow from a hammer or mallet. The earliest chisels were made from flint (a kind of stone) 10,000 years ago. Later, they were used by the Egyptians to carve stone for the pyramids.



Task 3 *Find the names for the following tools in the text and match them with the definitions:*

- a heavy sharp-ended tool for cutting wood or meat
- a tool that makes round holes
- a small pointed tool, often with a broad handle, for making holes in leather
- a metal tool with a sharp cutting edge at the end of a blade, used for cutting into or shaping wood, stone, etc.
- a steel tool with a rough face, used for rubbing down, making smooth, or cutting through hard surfaces
- a metal tool with jaws or a hollow end, for fitting over and twisting nuts
- a piece of string with a piece of lead tied to one end, used for measuring the depth of water or for finding out whether a wall is built exactly upright
- an instrument consisting of two movable arms joined at one end, used for holding or lifting various objects

Task4 *Complete the sentences with appropriate verbs*

operate, chip, scrape , drill, abrade, move back and forth, peel, fit, grind, stamp out, beat, turn, rotate, direct, cut, file, polish, ram

a) They … a smoke alarm to the ceiling.
b) He … his glasses with a handkerchief.
c) What skills are needed to … this machinery?
d) He … through the wall by mistake.
e) We … away the top layer of the wall paper.
f) Stay well away from the helicopter when the blades start to … .

g) The hinges are … … of sheets of metal.
h) The metal had been … flat.
i) It needs skills to … a block of stone into a recognizable shape.
j) The label will … off if you soak it in water.
k) The machine … a powerful beam at the affected part of the body.
l) I can't get the screw to … .
m) They used a special stone for … knives.
n) You need a powerful saw to … through metal.
o) It is difficult to … diamonds.
p) Shapers … the cutting tool … … … over the surface.
q) Presses are used to … material against a hard surface.

Let's have a look at some other devices or tools.

The Swiss Army knife

History

In 1891, Karl Elsener, then owner of a company that made surgical equipment, discovered to his dismay that the pocket knives supplied to the Swiss Army were in fact made in Germany. Upset, he founded the Association of Swiss Master Cutlers. Its goal was simple: Swiss knives for the Swiss Army.

Upon a suggestion by his engineer friend, Jeannine Keller, Elsener began working on what was the predecessor to the modern Swiss Army knife, called the "Soldier's Knife". The original had a wooden handle, as opposed to the plastic and metal seen today, and featured a blade, a screwdriver, a can opener, and a punch. This knife was sold to the Swiss army, but Elsener was not satisfied with its first incarnation. In 1896, after 5 years of hard work, Elsener managed to put blades on both sides of the handle using a special spring mechanism, allowing him to use the same spring to hold them in place, an innovation at the time. This allowed Elsener to put twice as many features on the knife; he added a second blade and a corkscrew.

Elsener, through his company Victorinox, managed to corner the market until 1893, when the second industrial cutlery of Switzerland, Paul Boechat & Cie headquartered in Delémont in the French-speaking canton of Jura, started selling a similar product. This company was later acquired by its then General Manager, Theodore Wenger and renamed the Wenger Company. In 1908 the Swiss government, wanting to prevent an issue over regional favouritism, but perhaps wanting a bit of competition in hopes of lowering prices, split the contract with Victorinox and Wenger each getting half of the orders placed. By mutual agreement, Wenger advertises as the *Genuine Swiss Army Knife* and Victorinox uses the slogan the *Original Swiss Army Knife*. However, on April 26, 2005, Victorinox acquired Wenger, thus once again becoming the sole supplier of knives to the Swiss Army. However, on the consumer side Victorinox has stated that it intends to keep both brands intact.

In 2006, Victorinox produced a knife, with 85 devices and 110 functions, to commemorate Wenger's 100th anniversary in the Swiss Army knife business.

Various models of Swiss Army knives exist, with different tool combinations for specific tasks. The simplest models sold include only a single blade. The most common tools featured are, in addition to

the main blade, a smaller second blade, tweezers, toothpick, corkscrew, can opener, bottle opener, phillips-head screwdriver, nail file, scissors, saw, file, hook, magnifying glass, ballpoint pen, fish scaler, pliers and key chain. Recent technological features include USB flash drives, digital clock, digital altimeter, LED light, laser pointer, and MP3 player. The official army model also contains a brass spacer, which allows the knife, with the screwdriver and the reamer extended at the same time, to be used to assemble the Swiss Army assault rifles.

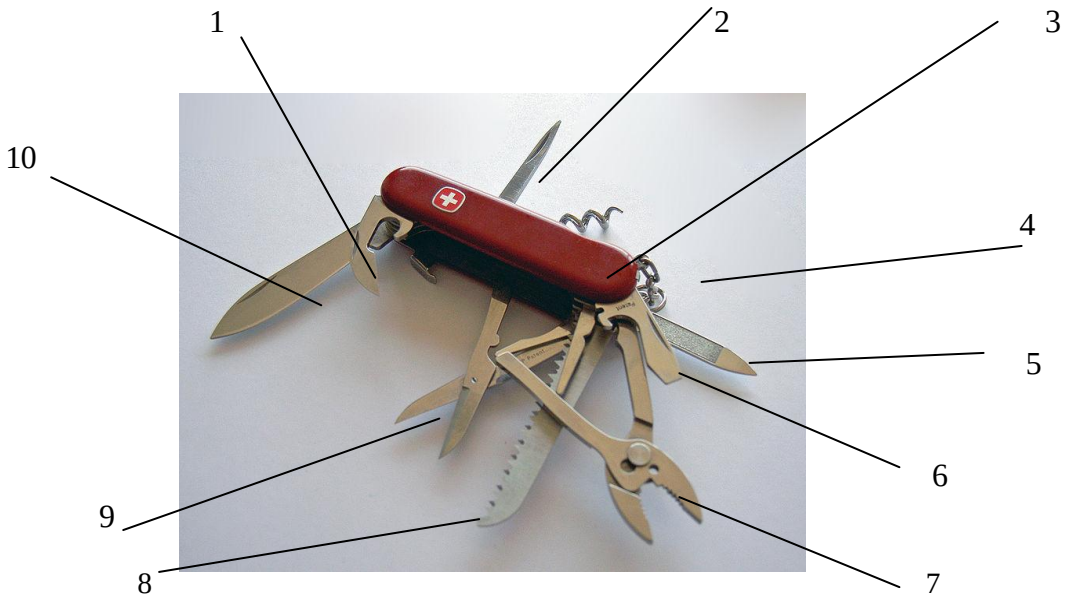
The standard full-size SAK is approximately 9 cm (3.5 inches) long and 2 cm (0.75 inches) wide; smaller models are typically about 6 cm (2.25 in) long and 1.5 cm (0.5 in) wide. Thickness varies depending on the number of tools included. Although red SAKs are most common, there are many colours and scales available. Many textures, colours, and in fact, shapes are now popping up in the Swiss Army Knife.

As of 2007 the most technologically advanced model includes a laser pointer and a 2GB detachable USB flash drive. Wenger has even manufactured a $1200 Swiss army knife that includes every implement the company has ever made.

(taken from the wikipedia)

Questions:

1. Where were pocket knives for the Swiss Army originally produced?
2. What did the so-called ‘Soldier’s knife’ consist of?
3. What was added by Elsener and what was an innovation at that time?
4. What is the difference between the Wenger and Victorinox knives?
5. Which company produces SAKs for the army today?
6. What kind of SAK was manufactured in 2006?
7. What are the dimensions of a standard SAK?
8. Which modern electronic features may a SAK provide?
9. Are there only red SAKs available?



Explain the (function of the) following tools:

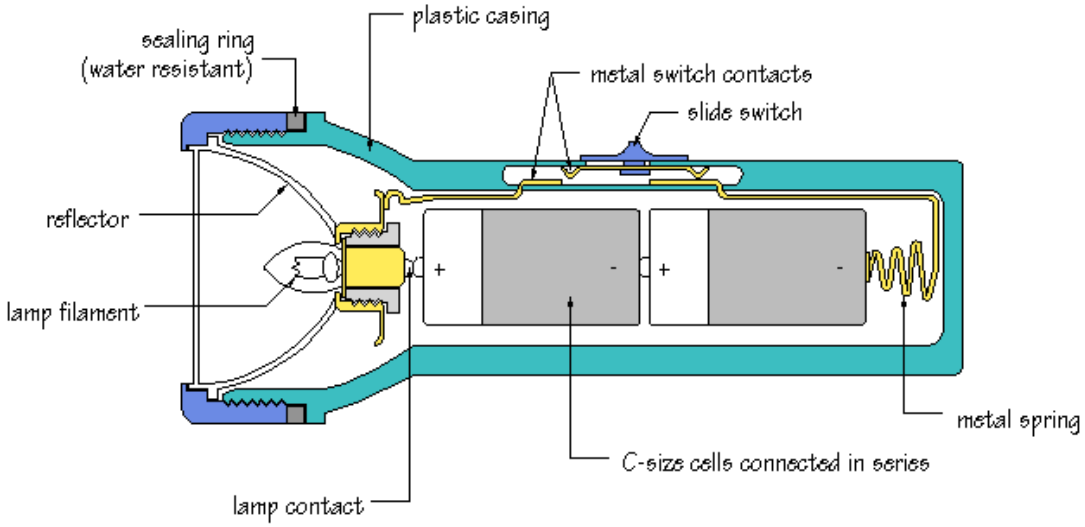
a) tweezers
b) toothpick
c) altimeter
d) magnifying glass (magnifier)

The torch

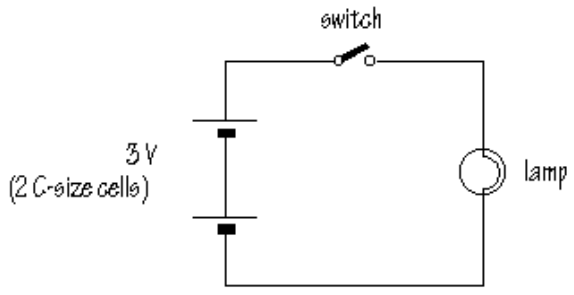
Read the following text on Torch and be prepared to explain its electric features afterwards. *[from doctronics.co.uk/circuits.htm]*

Why did the designer choose this particular combination of materials? The metal parts of the torch must conduct electric current if the torch is to function, but they must also be able to stand up to physical forces. The spring holding the cells in place should stay springy, while the parts of the switch must make good electrical contact and be undamaged by repeated use.

The lamp and reflector make up an optical system, often intended to focus the light into a narrow beam. The plastic casing is an electrical insulator. Its shape and colour are important in making the torch attractive and easy to handle and use.



A different way of describing the torch is by using a circuit diagram in which the parts of the torch are represented by symbols:



There are two electric cells ('batteries'), a switch and a lamp (the torch bulb). The lines in the diagram represent the metal conductors which connect the system together.

A circuit is a closed conducting path. In the torch, closing the switch completes the circuit and allows current to flow. Torches sometimes fail when the metal parts of the switch do no make proper contact, or when the lamp filament is 'blown'. In either case, the circuit is incomplete.

Complete the table

component	function	material
reflector	reflect light to increase efficiency	shiny metal (aluminium)

Plug - BS 1363

BS 1363 (British Standard) is the standard which defines what is colloquially know as the **13 Amp plug**, which is the most common type of mains power plug in the British Isles.

A BS 1363 plug has two horizontal, rectangular pins for live and neutral, and above these pins, a larger, vertical pin for an earth connection. Unlike many other plugs, the earth pin is mandatory as it is needed to open the shutters. It also polarises the plug. Moulded plugs for unearthed, double-insulated appliances can substitute this contact with a plastic pin.

These plugs are required to carry a cartridge fuse, manufactured to BS 1362, which can be rated at 3, 5, 10 or 13 amperes. The maximum load that can be placed on a socket, including double and triple sockets, is 13 A. The double sockets are unfused, so it is possible to draw up to 26 A before hitting the rated current of any overcurrent protection. However when drawing up the standard it was decided to only require double sockets to be able to take 13 A total!. Most sockets can stand more than this at least in the short term but continuous running at 26 A *will* result in a damaged socket. Surprisingly however this has not posed a problem in practice probably because of the fact that very few domestic appliances draw the full 13 A for any significant time. Triple and larger sockets are fitted with a 13 A fuse of the same type used in the plugs.

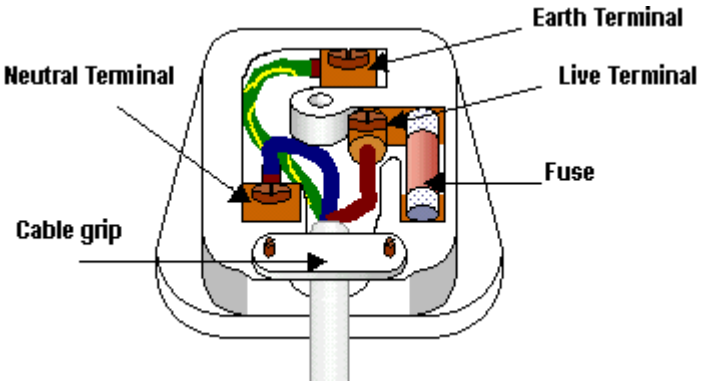
The plugs and sockets are designed to carry up to 250 volts AC, 50 hertz. The UK power system is officially 230 V +10% −6%. However, in reality, voltages are generally closer to 240 volts than 230, as the old standard before European harmonisation was 240 V ±6%, and most supplies installed to the old standard meet the new standard.

This plug is often referred to as the safest in the world and to many outsiders it often seems excessively safety conscious. The high extraction force can be inconvenient, particularly to people with weak hands, such as the elderly. To counter this plugs with handles and straps to fit existing plugs and provide a handle have been produced but never really caught on. The large size can make the plugs inconvenient when there are many plugs in a small space, as on power strips.

Three pin mains plug (UK).

This diagram shows the wiring of a British type G three pin plug. Externally it looks like this:

Taken and adapted from wikipedia.org



***Explain**:*

- live pin
- neutral pin
- earth pin

What does the underlined sentence express?

a) aThere is no chance to use a plug without an earth pin.
b) Special plugs have earth pins made of plastics.
c) You don't need an earth contact with moulded plugs.

Why are plugs equipped with fuses?

What is disadvantageous of these plugs?

Task *Complete the sentences with details from the interview.*

The EU began discussions on a standard European _____ in _____ .

Brussels gave up the idea in _____ because some countries were not willing to give up _____ _____ _____ .

There is already a standard plug for small appliances like _____ and _____ that you can use everywhere except in the _____ .

This standard plug is a flat _____ - _____ plastic plug that is connected to the _____ at the _____ .,

It would cost _____ million euro to convert to a standard European plug for heavy appliances in _____ alone.

In the whole of the _____ , the costs would be _____ times the German amount.

Conversion would take at least _____ years.

Conversion would also create 600.000 tons of _____ and _____ waste.

(taken from: New Focus on Success)

Lasers

Let's have a look at devices that are used in your profession.

a) ***Which different types of lasers are named in the text.***
b) ***Where else can lasers be used? What is not mentioned in the text? What would you add?***
c) ***Underline important phrases that you may need to explain the function/ the usage of a device.***

Laser applications:

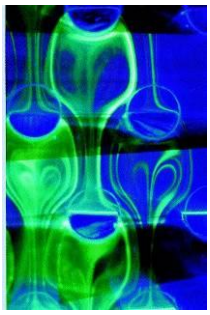
The light produced by lasers is in general far more monochromatic, directional, powerful, and coherent than that from any other light sources. Nevertheless, the individual kinds of lasers differ greatly in these properties as well as in wavelength, size, and efficiency. There is no single laser suitable for all purposes, but some of the combinations of properties can do things that were difficult or impossible before lasers were developed. A continuous visible beam from a laser using a gas, such as the helium-neon combination, provides a nearly ideal straight line for all kinds of alignment applications. Lasers have come to be widely used for alignment in large construction, e.g. to guide machines for drilling tunnels and for laying pipelines. A pulsed laser can be used in a light radar, sometimes called LIDAR, and the narrowness of its beam permits sharp definition of targets. As with radar, the distance to an object is measured by the time taken for the light to reach and return from it, since the speed of light is known. Distances can be measured from an observatory on Earth to the lunar mirror with an accuracy of several centimetres. Simultaneous measurements of the mirror's distance and direction from two observatories on different parts of the Earth could give an accurate value for the distance between the two observatories. A series of such measurements can tell the rate at which continents are drifting relative to each other. A vertically directed laser radar in an airplane can serve as a fast, high-resolution device for mapping fine details, such as the

contours of steps in a stadium or the shape of the roof of a house. The high coherence of a laser's output is very helpful in measurement and other applications involving interference of light beams. Such devices are called laser interferometers. Very small displacements can be detected, and larger distances can be measured with precision. With lasers, these measurements can be carried out over extremely long distances. Laser interferometers are used to monitor small displacements in the Earth's crust across geological faults. In manufacturing, such devices are employed to gauge fine wires, to monitor the products of automated machine tools, and to test optical components.

The brightness and coherence of laser light make it especially suitable for visual effects and photography that simulate third dimensional depth--e.g., holography .The light from many lasers is relatively powerful and can be focused by a conventional lens system to a small spot of great intensity. Thus even a moderately small pulsed laser can vaporize a small amount of any substance and drill narrow holes in the hardest materials. Ruby lasers, for example, are used to drill holes in diamonds for wire drawing dies and in sapphires for watch bearings. For biological research, a finely focused laser can vaporize parts of a single cell, thus permitting microsurgery of chromosomes. Strong heating can be produced by a laser at a place where no mechanical contact is possible. Thus one of the earliest applications of lasers was for surgery on the retina of the eye.
(from: 1994-2000 Encyclopædia Britannica)

Look at the text and find the right synonyms for the underlined words:

The vast[1] range of commercial applications of laser technology is mirrored [2]in this course. The student choosing this specialization will be confronted with a variety[3] of topics covering materials processing[4], measurement Techniques[5], analytical science, optical communications technology, laser systems design[6] and medical applications of lasers.



1enormous quick limited
2 given reflected shown
3 range number group
4 deal with treat manufacture
5 technology engineering methods
6 outfit fashion outlining

The past two decades[7] have experienced a flood[8] of industrial activity in these fields and there is no ebbing[9] of this trend in sight. Exemplary for the types of rapidly growing[10] sectors employing[11] these technologies are the automobile industry (precision welding, automation control, rapid[12] prototyping), semiconductor manufacturing[13] (wafer annealing and purification[14], quality control, precision component trimming[15]) as well as the communications market (fibre[16] optical communications networks, optical data storage[17], 2D and 3D display technology).

7 years centuries 10 years
8 shortage overflow stream
9 stop increase diminish
10 increase remain build
11 use apply work
12 fast slow constant
13 handling treatment production
14 distillation cleansing encoding
15 cutting decorating sporting
16 cable cord thread
17 keeping memory warehouse

LEDs

Put the verbs in brackets into the correct form.

It's gloomy and cool in the _____ (unlight) room. Dr. Norbert Stath _____(throw) a switch, and suddenly everything appears to be _____ (bath) in the light of glittering stars. Hundreds of tiny dots of light _____(illuminate) arrangements of plastic roses. A lighting console plays a combination of colours and ***sounds, and a slot machine blinks on, _____(invite) us to try our luck. Of course, more serious*** applications _____ also _____(demonstrate) in the showroom of Osram Opto Semiconductors in Regensburg, Germany — like a traffic light or an emergency exit sign. Stath, who's in charge of innovation management, points out several unique automobile tail lights. Phaeton, Maybach and other illustrious brands _____ (mention). All of these exhibits have one thing in common: they're illuminated by light-emitting diodes, or LEDs. We are all quite familiar with these tiny light sources that _____(tell) us which washing machine program _____ (select) or whether the airbag in our car is operational, and provide safety illumination on bicycles even when the bike isn't moving.

How is white light achieved? Which problems have to be attacked?

But in the future these tiny starlets will also be used more and more in applications served by incandescent or fluorescent bulbs today: as headlights in cars, as flash units in cell phone cameras, or even to illuminate rooms. But before LEDs can achieve the status of a universally used light source, scientists still have some work to do. While the lifespan of red LEDs can be as long as 100,000 hours (compared with 1,000 hours for an incandescent bulb), their brightness is still insufficient for many applications. In particular, the highly popular white LEDs — which incorporate additional fluorescent materials to create yellow wavelengths besides blue to produce white light — generate much less brightness than conventional light sources.

Name advantages of LEDs

LEDs already leave other technologies in the dust when it comes to advertising billboards and sports stadiums. Their power consumption is moderate, so they produce little heat, Moreover, individual LEDs for individual image pixels can be controlled independently of one another.

As a result, the image screen can be bent in any direction, or even reach around a corner. The organizers of the 2008 Olympics in Beijing are planning to set up LED image screens hundreds of square meters in size on the outer walls of the stadiums, on which the action will be displayed.

Among the three basic colours of red, green and blue, it's the green LEDs that remain a source of concern due to their low efficiency.

The Proscope **(Listening and Watching)**

Task 1 *Please put the following topics into the correct order. There are two topics which you do not need to use.*

- Adjusting the proscope for depth of field
- Advantages and fields of applications of the proscope
- Dark field illumination
- Experience users of the proscope have made
- General information and necessary computer support
- The price of the proscope
- Using the proscope as a touch-focus device
- What you can do with the proscope

Task2 *Complete the following notes about the proscope.*

- a handheld _____ for _____
- necessary: latest driver – available from _____
- what you can do with the proscope:
  - look at coins and banknotes
  - look at _____
  - watch the movement of _____
- touch-focus device, i.e. you can see what you touch with a magnification, e.g. 50 _____
- it is also possible to hold _____ from the object, in which case a stand or tripod should be used
- to remove the lens you need to _____
- 2 possibilities how to snap images:
  - _____
  - _____
- equipment is light and easy to use, therefore popular in _____ _____

Writing/ Presentation *Describing technical devices.*

Write/ Speak about tools that you may have to use in your future job. Define the tools, describe them (see below), their function, and their usage in a brief way.

1. What do you need?

- Name/ parts/ materials/ shape/ dimensions/ weight/ angles/ colour
- Important features
- Main function
- Usage
- How it works

2. Describing shapes:

Do you remember the words (nouns and adjectives) you need?

Kreis/ Quadrat/ Rechteck/ Dreieck/ Röhre/ Kugel/ Würfel/ oval....

It's ball-shaped.

It's round.

3. Describing dimensions:

The instrument is about the size of a matchbox.

It is not bigger than an egg.

It is a large device (a tiny gadget).

It is 5 centimetres ……. (complete the sentence!!)

4. Usage/ Function

Use phrases from the texts in this unit.

e.g. measure/ adjust/ control/ cut/ form/ shape/ convert ….

5. Describing important features/ properties

This device is…

… solid, reliable, user-friendly, energy-saving, heavy etc.

Revision – Vocabulary

Task 1 *Find the names of the tools or a description*

small hand operated instrument for fastening

papers, together with staples _____

cutting instrument with two blades, pivoted

in the middle, which cut as they come together _____

tool with long jaws which have flat surfaces that can be brought together for holding, bending twisting or cutting wire _____

tool with a sharp cutting edge at the end, for shaping wood, stone or metal _____

metal tool that has a long blade with a sharp toothed edge, worked by hand or mechanically (by pushing it backwards and forwards) _____

tool with a handle and a blade that fits into the head of a screw to turn it _____

tool with a heavy metal head at right angles to the handle used for breaking things, driving nail _____

_____ pair of compasses

_____

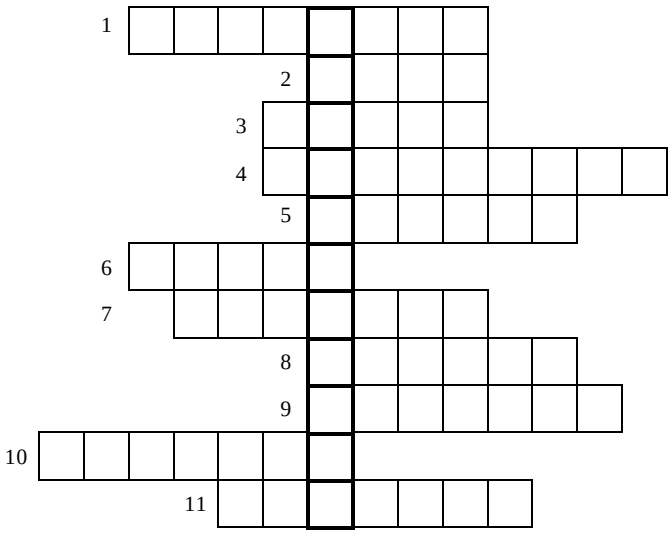
_____ drill

_____

Task 2 *Fill in appropriate words (from the texts above, use the letters in brackets).*

A dipstick is used to _____(saeerum)**1** how much oil is left in the engine.
He _____(ckdhece)**2** the container for cracks or leaks.
The brakes need to be _____(satjeudd)**3**.
Hot water is _____(eroncevtd)**4** to electricity by a turbine.
In this scene, the camera _____(uscefso)**5** on the actor's face.
The missile could be _____(eleecdftd)**6** away from its target.
The diamond is _____(nodemtu)**7** in gold.
The traffic lights are _____(ontcerolld)**8** by a central computer.
First, _____(oltp)**9** the temperature _curve on the graph. This machine uses the power of wind to _____(regeaent)**10** electricity.
No new evidence _____(rgdeeem)**11** during the investigation.

Task 3 *Complete the crossword puzzle.*



Definitions:
down: a tool for fastening little metal things

across:

1. This tool is used to cut paper.
2. you use this for the Faraday experiment
3. a tool that makes round holes
4. a two-dimensional shape
5. You use it to twist nuts.
6. Opticians have to ... lenses carefully.
7. to oxidize
8. a colour of the spectrum
9. During experiments you must be aware of high ... .
10. long-lasting
11. A ... material contains iron

machine, appliance, apparatus, tool, implement, utensil, device, gadget, instrument

What is what?

a) A … is an object with a simple design that you hold and use to do a particular job, e.g. *a hammer*.
b) An … is designed for a technical task, especially one that requires a lot of skill, e.g. a surgeon's knife, *a microscope.*
c) An … is generally used outside, esp. to help with work in the garden, e.g. a spade.
d) A … is a piece of equipment that does a particular job, for example takes measurements, e.g. *a temperature control ...*
e) A … is a piece of equipment that uses power to do a particular job, it is usually large and stays in the same place, e.g. a *washing ...*
f) An … is a piece of electrical equipment used in your home. This word is especially used by the companies that produce and sell them, e.g. the world's largest producer of *household ...*
g) An … has several pieces that must be connected and is used to perform a specific function, e.g. a *breathing ...*
h) A … is small and modern. You may not need it but you can use it to perform a task more easily, e.g. *The car is fitted with some clever little ...*
i) A … is a useful household tool or object, e.g. *cooking .../ writing ...*

Electrian´s tools and their usage

Complete the table with the words given

wire stripping and terminal crimping pliers with bolt cutter;

electrical tape; needle-nose pliers;

Lineman's pliers (combination pliers)

Mains tester or test lamp

used to cover wires or to insulate	
used to remove insulation material thoroughly	
used to grip small objects, bend or reposition wires or even cut them in narrow openings or cavities or when wiring is crowded	
used to find out whether a voltage/ current is applied to a wire	
used to cut, bend, position wires, but also to hammer other tools or materials, can apply some heavy force, used in many trades	