Fachhochschule Jena
University of Applied Sciences Jena

FB Grundlagenwissenschaften
Sprachlehrzentrum

Electrical Engineering 2nd term (SS 2010)
Technical English II
Presenting facts and figures

This course familiarises you with technical English for electrical engineers and enables you to give professional presentations. The special focus is on vocabulary, reading, listening and speaking skills. The requirements are as follows:

- an 8-minute presentation (details will be given in class)
- successful completion of a written test on vocabulary/ structures

	Presentation skills	➢ giving effective presentations in English
5.	**Basic electrical engineering**	➢ components, circuits, fields
6.	**Engineering materials**	➢ properties ➢ semi-/conductors, insulators
7.	**Instruments and tools**	➢ history of tools ➢ classification ➢ design and usage
8.	**Physical and technical units, measurements and shapes**	➢ SI units ➢ basic and derived units ➢ measuring instruments ➢ procedures
9.	**Experiments, laboratories, safety regulations**	➢ lab tour ➢ electromagnetism ➢ electric fields ➢ safety precautions
	listening comprehension	➢ worksheets

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Presentation Skills
What makes a good presentation?

List all the things you can think of.

1. **overall**
Who is your audience?

2. **system**
Plan carefully.

3. **delivery**
Speak fluently.

4. **body language**
Keep eye contact.

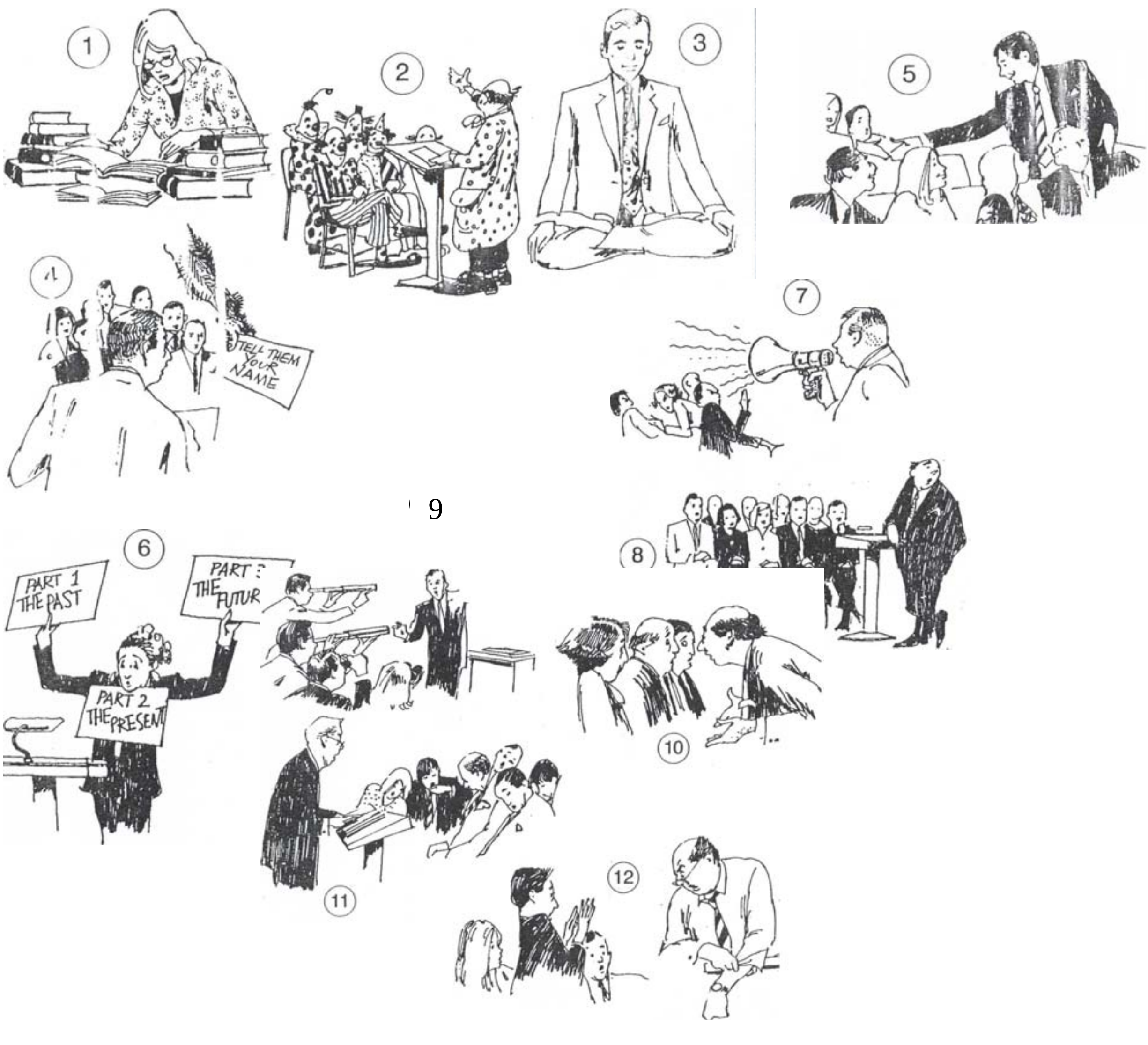
5. **visual aids**
Use equipment professionally.

Watching: What makes a good presentation?
Watch the film and note down what Joanna does badly.

Tips for good presentations

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

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.



Problems

If it can go wrong, it will go wrong! (Murphy)

Always anticipate potential problems. How would you deal with these situations?

- Someone walks in late.
- A listener falls asleep.
- Your laptop, with all those beautifully prepared slides, crashes.
- You drop all your back-up transparencies on the floor.
- Somebody calls out, "Rubbish!"
- Two people get up and leave.
- A mobile phone rings.
- One person keeps asking you questions.
- The audience looks bored.
- You realize you don`t have enough time for everything.

The classic structure

Order these parts as they would appear in a presentation..

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

1.

2.

3.

4.

5.

6.

Allocation of time during presentation

Which part of the presentation should be that long?

Talk duration	less than 15 min.	more than 15 min.
	20% of talk time	10% of talk time
	60% of talk time	80% of talk time
	20% of talk time	10% of talk time
Questions and answers	20 % of total time	

Structure – exercise

Suzy Capra wants to give a good presentation so she has made a list of some of the things she wants to say. Unfortunately she has dropped all her language cards (a-j – *you will see them on a transparency*) on the floor.
Help her to put them in the right order by matching them with the cues (1-10).

cues:

1. give subject of presentation.________________________________
2. questions ok.________________________________
3. lead into part 1: History.________________________________
4. summarize and close part 1.________________________________
5. link to part 2: Options. ________________________________
6. visual aid: show figures (transparency).________________________________
7. summarize and close part 2.________________________________
8. move on to part 3: Recommendations.________________________________
9. close.________________________________
10. invite further questions.________________________________

"If you have an important point to make, don't try to be subtle or clever. Use a pile driver. Hit the point once. Then come back and hit again. Then hit it a third time – a tremendous whack". Winston Churchill

When you look at the information you want to provide...

...you have made an assertion (your main claim) and several supporting assertions. Now you need to back them up with evidence to explain or prove your claims.

The most commonly used forms of evidence are:

- facts and figures, statistical evidence
- ...
- ...
- ...
- ...

☝ Cite evidence that your audience will find credible. Logical appeals count most!

Three Presentation Essentials

> *"Tell me and I will forget,*
> *Show me and I will remember,*
> *Involve me and I will understand".*

1. Use visual aids where you can
2. Rehearse, rehearse, rehearse
3. The audience will only remember **three** messages

The Rule of 3 - We remember 3 things.
The rule of three is one of the oldest - Aristotle wrote about it in his book Rhetoric. Lists of 3 have been used from early times up to the present day. They are particularly used by politicians and advertisers who know the value of using the rule of 3 to sell their ideas.

- Veni, Vidi, Vici (I came, I saw, I conquered) - Julius Caesar**
- "Friends, Romans, Countrymen lend me your ears" - William Shakespeare
- "Our priorities are Education, Education, Education" - Tony Blair
- Stop, look and listen - Public safety announcement
- …

The introduction

> *"Well begun is half done."*

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

- Win your audience over – hook them with an amazing fact, a personal story, a picture…
- Build up rapport: include a human touch, find common ground, listen, don't argue, care about them, help them to understand
- Make the presentation interactive - if you can. Involve the audience.

The introduction

language focus

Find headings for the phrases of each group.

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…
		describe…
➢ The	subject of my	talk
	focus	presentation
	topic	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.

Introduction - exercise

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. Here's how the experts suggest you 'hook' your audience:

- Give them a problem to think about.
- Give them some amazing facts.
- Give them a story or personal anecdote.

Task:
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 Colombia'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. **Have you ever wondered why it is that** Americans are easier to sell to than Europeans? And why nine out of ten sales gurus are American? You have? **Well, if I could show you** what stops Europeans buying, **would you be interested**?
7. **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.
8. **How many people here this morning** hate going to meetings? Just about everybody, **right**? Well, imagine a company where there were never any meetings and everything ran smoothly. **Do you think that's possible?**
9. **Have you ever been in the situation where** you've had to negotiate with the Japanese? **I remember when** I was working in Nagoya end 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!

Can you think of any other "hooks"?

- …
- ...

Introduction - exercise

Task 1:
Complete this presentation introduction with words from the list.

(l) talk about	(4) look at	(7) points of view
(2) questions	(5) brief	(8) finally
(3) hear	(6) act as	(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 2:
Use one of the following expressions to replace each of the expressions in italics in this introduction.

(l) don't hesitate	(4) a chance	(7) I take care of
(2) I'm delighted	(5) sections	(8) go through
(3) in more depth	(6) my purpose is	(9) 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.

Delivering

How we take in information during a presentation according to Albert Mehrabian, psychologist and author:

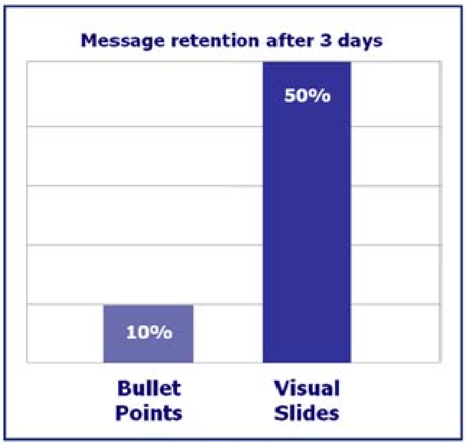
You can argue about these percentages, but successful presenters clearly manage all three elements well.

You will be on display. Your audience will watch you nearly all the time.

- Make sure you are dressed appropriately. Your appearance should be professional and reflect your position and relationship with the audience. Clean your shoes.
- Maintain eye contact with the audience.
- Use **A5 cards** for your notes. Never write full sentences on them.
- **Reading out a presentation is an absolute NO-NO!**
- Keep an eye on the time.
- If you are running out of time do not speak faster, cancel a minor point.

Language

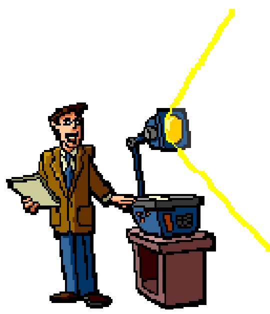
- Simple and clear language
- Short words and sentences
- Link sentences, paragraphs/ part logically.
- No jargon unless you are certain your audience is familiar with it.
- Use active instead of passive verbs. Active is easier to understand and more powerful and personal.
- **Signposting** as navigation through the presentation helps the audience with orientation. Signals where you are.
- Do it all along the presentation.



Visual aids

"A picture can say more than a thousand words". Confucius

Dos:	***Don'ts:***
when designing the visual: ➢ select your visuals carefully ➢	➢ don't choose a visual which distracts from your point ➢
when delivering the visual: ➢ use a pointer ➢	➢ don't block the view ➢



Task 1

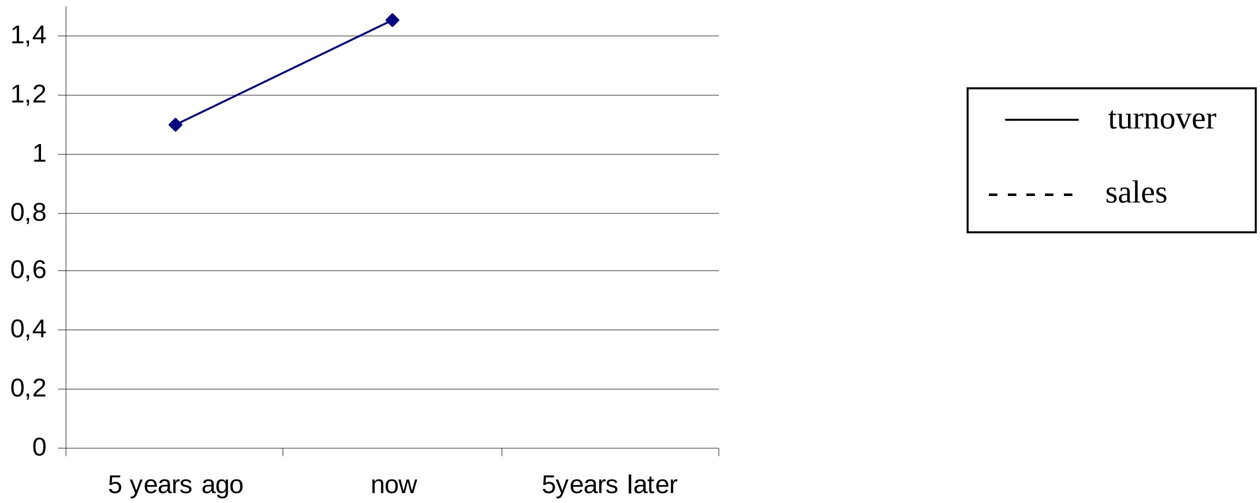
Compare the visuals, their advantages and disadvantages.

	advantage	disadvantage
blackboard		
whiteboard		
overhead projector/ slides		
flip chart		
handout material		
computer projection, ppp		
physical items passed around		
video		
others		

Task 2

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.

Graph 1

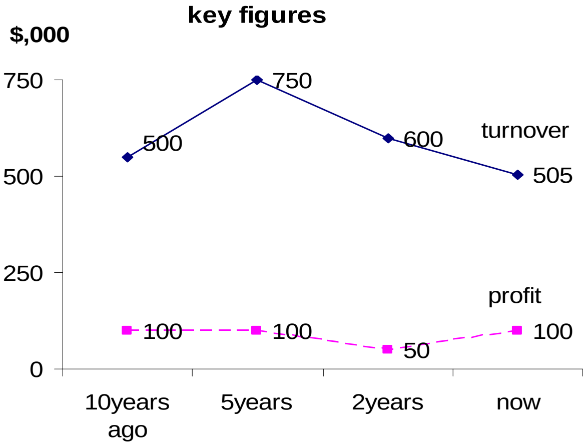


Complete this description with information from Graph 2 below.

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.

Graph 2



Technical Hints for Slides

number of slides

In presentations less really is more. No one ever complained of a presentation being too short.

Guy Kawasaki (a venture capitalist who listens to hundreds of product pitches) evangelises a technique to keep all presentations to less than **10 slides** and no more than **20 minutes** and a **font size of at least 30**.

- no sentences, just catchwords
- max. **24** words on a slide
- up to **6** bullet points/ slide
- bullet text: short summary of your point, **not your exact words**

fonts

- simple fonts
- Limit Serif Fonts (Times Roman, Garamond, etc.) to headlines. They often look busy on screen. Sans Serif Fonts (Arial, Helvetica) are easier to read when projected
- Such font for headings only, if ever.
- consistence of font and content: historical society **steel construction**
- mixture of upper and lower case
- BLOCK CAPITALS ARE CLEAR BUT NOT EASY TO READ
- Use **max. 2-3 different fonts** in 1 presentation.
- spacing between the lines: min. 1.5
- font size:
- title: 40 pt
- text: min. 20pt (s.a.) , but it also depends on the room

layout

- be consistent with everything: layout, fonts, commas, capitalisation etc.
- at least **30% of the slide should stay empty**
- decide: Do you really want the audience to read your name on every single slide?
- number the slides

And bdon't fergit ta spwll chrck!!
Good luck.

tables

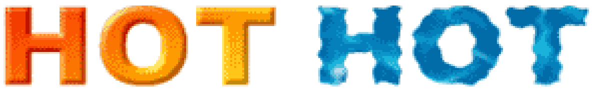
- max 4 rows, 4 columns
- use a minimum number of digits

effects and animation

- use with care
- use only if appropriate and not too distracting
- no sound effects please
- they may not work during the presentation

colours

- Use them with care.
- Be systematic. Same colour for same idea.



- not more than 3 different colours
- Colours have symbolic character.
- Colours can influence feelings and perception.
- The effect of colours may differ in men/ women, in another culture.

Colour combinations

	RED	ORANGE	YELLOW	GREEN	BLUE	VIOLET
RED		POOR	GOOD	BEST ?	GOOD	POOR
ORANGE	POOR		POOR	GOOD	BEST	GOOD
YELLOW	GOOD	POOR		POOR ?	GOOD	BEST
GREEN	BEST ?	GOOD	POOR		POOR	GOOD ?
BLUE	GOOD	BEST	GOOD	POOR		POOR
VIOLET	POOR	GOOD	BEST	GOOD ?	POOR	

Body language

"*The most important visual is YOU!*

Effective body language can enhance what you are saying

The major part of communication is non-verbal.
55% is visual (body language, eye contact),
38% is vocal (pitch, speed, volume, tone of voice),
7% is words

a. Watch Versions 1 and 2 of the video with no sound. As you watch, take notes on Dr Linden's body language. Use this checklist to help you.

Checklist

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

Body language:

Dos:	***Don’ts:***
➢ Control yourself. ➢ Think openness. Remove physical barriers – podiums, computers, chairs ➢ … ➢ … ➢ … ➢ …	➢ Do not fidget. ➢ Do not overdo any of the Dos. ➢ … ➢ … ➢ … ➢ …

Use your voice efficiently:

Dos:	**Don’ts:**
➢ Speak clearly. ➢ … ➢ … ➢ …	➢ Avoid high pitch voices. ➢ … ➢ … ➢ …

b. Watch Version 2 of the video again, this time listening to the sound. As you watch, underline the expressions in these extracts which are strongly emphasized. The first has been done for you.

1. These cost cuts are going to cause considerable pain.
2. We need to draw up a plan of action. I have put some ideas on the board.
3. These are some of the measures we could consider. There are broadly three approaches.
4. First, we could accept the cuts and reduce staff drastically. Secondly, we could fight and hope to achieve some reduction in the level of the cuts. Or thirdly, and this is what I support, we could put forward an alternative proposal. Now, this would mean …

language focus

Emphasizing

Strong adverbs intensify adjectives:

- *We've had an **extremely** good year.*

Adverbs can be total, very strong, or moderate.

TOTAL
- *absolutely (fantastic)*
- *completely (awful)*
- *entirely (depressing)*

VERY STRONG
- *extremely (good)*
- *very (bad)*

MODERATE
- *fairly (safe)*
- *reasonably (expensive)*
- *quite (cheap)*

Minimizing

Look at the way the following expressions of degree and uncertainty modify, or minimize, the message:

- ***It seems** we will have to delay the delivery.*
- *The Chief Executive Officer **appears** to have left the country.*
- *It's **just** a little bit further.*
- *We're going to reduce our staff **a bit**.*
- ***Perhaps** we should consider resigning.*
- *There **might** be another way.*
- *I **tend to** think we should stop now.*
- ***To some extent**, the company has failed to realize its potential.*

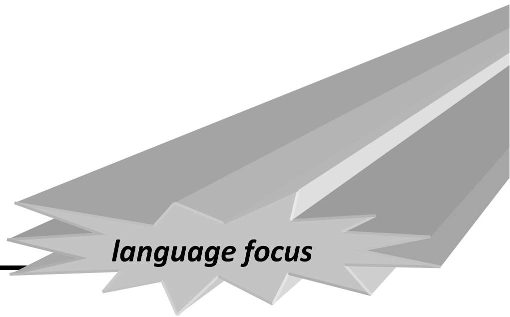
Intonation is also very important in giving more or less emphasis to what we say.

> "All is well that ends well".
> *Shakespeare*

Finishing well

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

- Signal the end
- Summarize what you want them to remember.
- Finish at a highlight
- Invite questions (and mean it!)



Finishing well - 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. . .*
- *I'd like to propose... (more formal)*
- *In my opinion, the only war forward is to…*

Concluding

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

Closing

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

Inviting questions

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

Finishing well - practice

Task 1

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 2

Make full sentences by matching the correct halves. The first one has been done for you.

a Before we come to the end,	1 there are four major features.
b I' d be glad to answer	2 we start the discussion now.
c To summarize,	3 by quoting a well-known saying.
d We can conclude	4 we should reduce our costs.
e In my opinion,	5 any questions now.
f I' d like to suggest	6 I' d like to thank you for your participation.

Question Time

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

What is the best way to handle difficult questions after a presentation?

- Don't be afraid of the questions.
- Try to anticipate the questions
- Welcome the question or clarify the meaning.
- Take time to think.
- …
- …
- …
- …
- …
- …

Question Time - practice

You are going to role-play a TV interview. Working with a partner, decide which role to take -interviewer or interviewee-and read your role card. Prepare you questions and answers before you start.

Interviewer

A news story has just broken. Hammond Electronics Inc. (an American multinational) is going to close its plant in Southern Germany and move to Portugal. The closure will result in more than 2,000 job losses. Your job is to interview the Human Resources Manager at Hammond's European headquarters in Brussels. Cover the following question areas:

a reasons for relocation
b effects of relocation
c policy of company for European production
d future in Germany

Interviewee

You are the Human Resources Manager at Hammond Electronics Inc. (an American multinational). You are based at the company's European headquarters in Brussels. Hammond has just announced that it will close its plant in Southern Germany and move to Portugal, with the loss of 2,000 jobs in Germany. Your job is to answer questions about this decision. Prepare your answers in the following areas:

a reasons for relocation
b effects of relocation
c policy of company for European production
d future in Germany

Dealing with questions - language focus

language focus

Direct questions

- *Do you have any plans for a new production plant?*
- *Where do you plan to locate it?*

Polite questions

- *Do you mind if I ask you if/what/where/etc.*
- *Do you mind telling me if/what/where/etc.*
- *Can/Could you tell me …*
- *I'm interested to know …*
- *I'd like to know …*

Manipulating the question

- *That's a good point. I'd like to expand on that by saying …*
- *Well, before I could really address that question, we have to consider …*
- *Well, your question brings up another question, and that is …*
- *Well, there's no easy answer to your question but I would like to say …*

Clarifying a question

- *If I understand you correctly, you are saying/ asking…*
- *I didn't quite catch that?*

Putting the ball back in his/her court

- *That's an interesting question. What are your views on the subject?*
- *Well, you've obviously given this a lot of thought. Perhaps we could hear your ideas.*

Passing the question off

- *That's a subject that's still open to questions. Does anyone here have any opinions on the matter?*

Blocking the question

- *I'm afraid I'm not in a position to answer that.*
- *I'm sorry, but that's confidential information.*
- *I don't think that is an appropriate question for this forum.*
- *I don't think we should get into that right now.*
- *I'm afraid that's not my field.*
- *Can we talk about that on another occasion?*

Correcting misinformation

- *With respect, your question is based on wrong information. The true figures are …*
- *I don't know your source of information, but I'm afraid it's not correct.*

Answering multiple questions

- *Well, let me take your questions one by one …*
- *Well, in answer to your first question …*
- *If I may, I'll begin with your second question …*

Checking that the questioner is satisfied

- *Does that answer your question?*
- *Is that clear?*
- *Can we go on?*

a mixed bag of phrases

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, more4 _________________ , 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 ● expand ● move on ● options ● priority ● referring ● in conclusion ● on balance ● 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 first 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 - 24_________________ on those successes before we 25_________________ ."
"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. 26_________________ though, I think we stand to gain most from concentrating on southern Europe and I strongly 27_________________ we put all our efforts into further expansion in Italy, Spain and possibly Greece.
28_________________ , may I thank you all for being such an attentive and responsive audience. Thank you also for your pertinent questions. Are there any final questions?"

Evaluating the effectiveness

Use this assessment form to evaluate the presentation you are listening to.

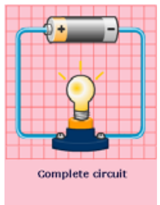
	poor	satisfactory	good	excellent
system structure introduction connections length ending	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐
manner audience contact interest confidence	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
delivery stance and posture hands eye contact movement fluency/ pausing use of notes	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐
visual aids number design relevance use	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
overall impression				

Unit Five basic electrical engineering

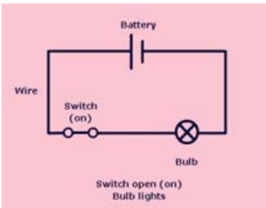
Circuits

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

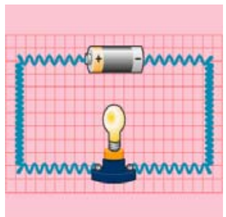
blows • breaks • brighter • brighter • buzzers • complete • completes • conductors • conducts • dimmer • greater • insulator • insulator • negative • negative • positive • positive • power source • prevents • resistance



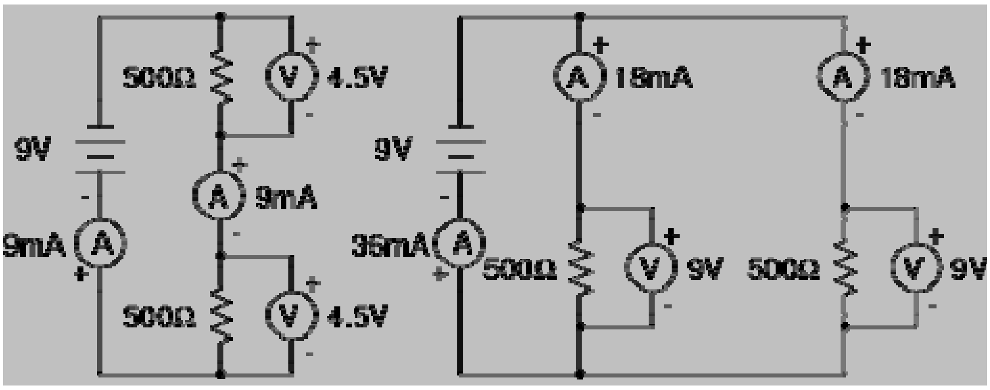
1. A circuit always needs a ________________**1)**, such as a battery, with wires connected to both the ____________**2)** (+) and _____________**3)** (-) terminals/ ends.
2. A circuit can also contain other electrical components, such as bulbs, ____________**4)** or motors, which allow electricity to 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.



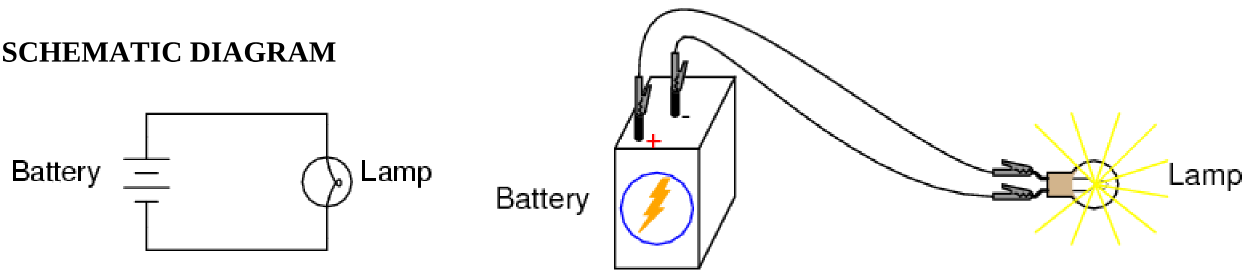
10. A battery is represented by a long line and a short line in a circuit diagram. The long line represents the _____________**13)** terminal of the battery; the short line, the _____________**14)** terminal.
11. Adding more batteries to a simple circuit will make a bulb ____________**15)**.
12. _______________**16)** 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.



Electrical circuits

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

SCHEMATIC DIAGRAM



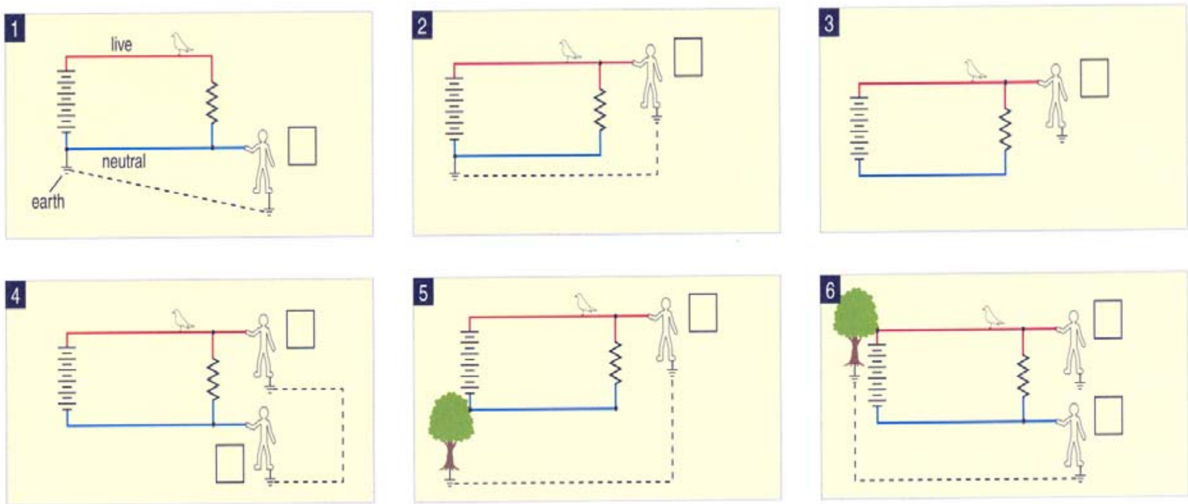
ILLUSTRATION

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.

Turn this simple circuit diagram into an experimental set up to be presented.

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.



2. 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.

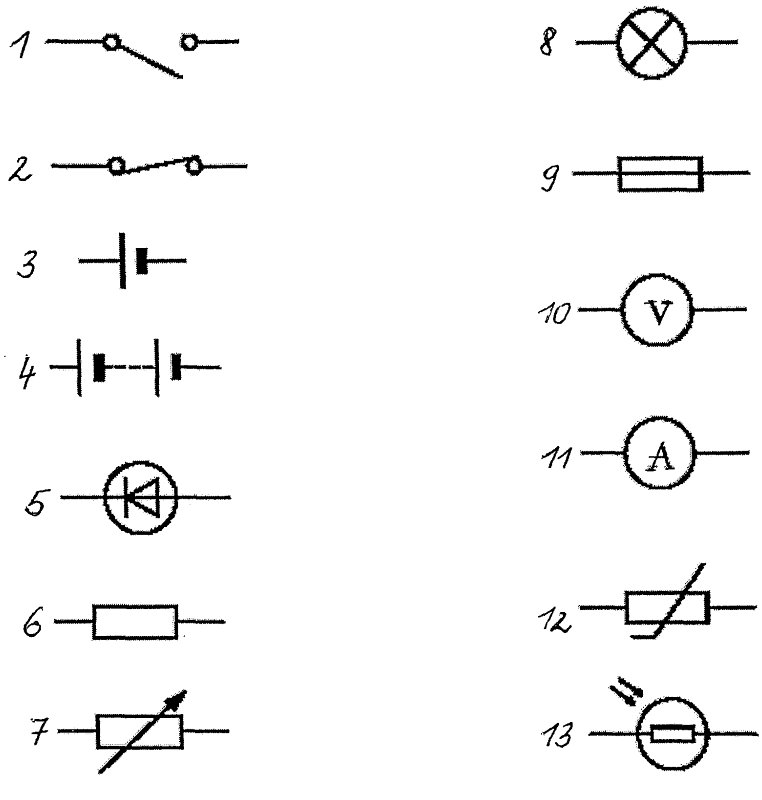
3.	Expressing **cause**:	*because, since, as*
	Expressing **result** (or effect):	*(and) so, (and) therefore, (and) as a result*

Replace the word(s) in italics with the word(s) in brackets. Make any necessary changes in punctuation and word order. Example:

1. Ben got a shock *because* he touched an earthed live wire. *(and as a result)*
Ben touched an earthed live wire, and as a result he got a shock.

2. Ron touched an earthed neutral wire, *and as a result* he was safe. *(because)*
3. *As* Bill touched an unearthed wire, he didn't get a shock. *(and so)*
4. Bob touched a live wire when a tree touched a neutral wire. *Therefore* he got a shock. *(because)*
5. Pete touched a live wire when a tree touched it. *So* he was safe. *(since)*
6. *Since* Tom and Del touched an unearthed wire, they got a shock. *(and therefore)*

worksheet What is what? What is missing?



'bæt^{ə}rɪ	swɪtʃ 'əʊpən	'el ˌdi: 'a:	'daɪəʊd	'veərɪəbl rɪ'zɪstə
fju:z	'vəʊltmi:tə^{r}	'æmɪtə^{r}	swɪtʃ 'kləʊzd	sel
θɜ:'mɪstə	rɪ'zɪstə			

Complete these sentences.

1. In a series circuit, the current is .... all around the circuit. In a parallel circuit, the .... is the same across each of the branches.
2. If the voltage across a resistor is 4V, and the current through the resistor is 0.4A, what is the resistance? Read your equation aloud
3. To measure the voltage across a lamp, a .... must be placed in .... with the lamp.
4. You have the following fuses: 1A, 3A, 5A, 13A. Which should be used in appliance where the current is 6A?
5. The current used in our homes is called .... current, because it changes direction many times a minute.

   Batteries, however, use .... current.

(taken and adapted from GCSE in a week, Byrne, K et al, 2002, Letts Educational)

Vocabulary list (to be completed by you)

ammeter
corresponding
current flow
electrical circuit
Incandescent lamp
light bulb
parallel circuit
resistor
series circuit
voltmeter

wiring, wire
fuse
diode
light, lit, lit
assume
discontinuity
terminal
electron

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 a _______________________________________
______________________ past any point in a wire. _______________________________ six
million million million electrons passing per second.
____, but electrons are very small
____. In electronic circuits,
_____________ ____ that is, thousandths of an
amp.

---

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,
____.

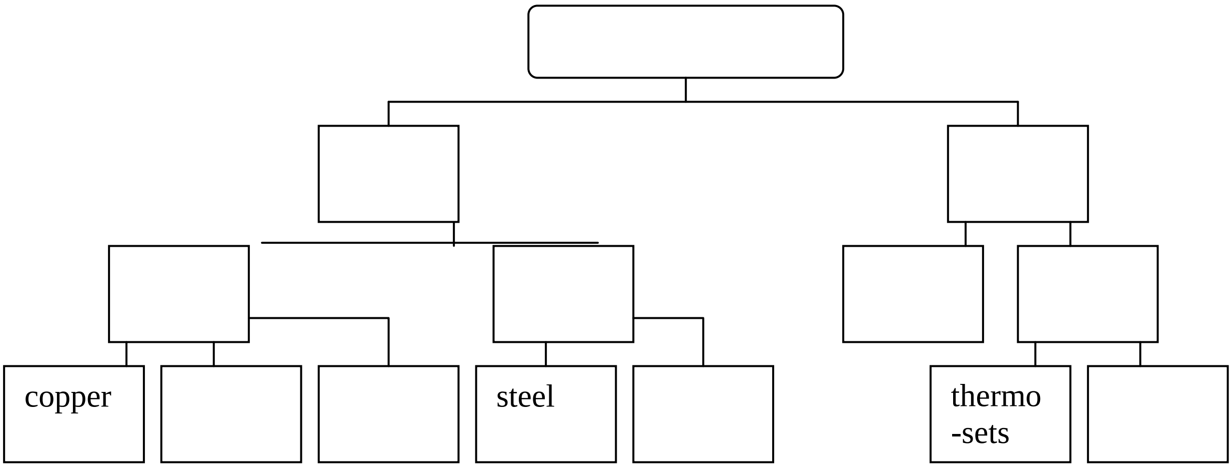
Unit Six engineering materials

1.1 Classification of engineering materials

Read the text and complete the diagram.

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 classified into two types - thermoplastics and thermosets. Thermoplastics can be shaped and reshaped by heat and pressure, but thermosets 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.



1.2 The properties of engineering materials determine their use.

Here are some properties of engineering materials. Match words with an opposite meaning.

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

Now 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 heat-resistant. 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.

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 substance

1.3 Some more properties

Match the phrases on the right with the explanations on the left.

1) Copper is very malleable
2) Rubber is elastic
3) Glass is durable
4) Plastics are insulating
5) A corrosive material
6) A conducting material

1. since electricity cannot pass through
2. allows electricity to pass through easily
3. because it can easily be rolled into a new shape
4. because it stretches under stress and regains its original shape when the stress is removed
5. because it doesn't corrode easily
6. causes rust

1.4 Word-building

Complete the following table. Use a dictionary if necessary.

Adjective	**Noun**	**Adjective**	**Noun**
malleable		soft	
ductile		rigid	
strong	tensile ___________	tough	
durable		hard	
elastic		flexible	
hard		light	

Note: “conducting” (adj.)

conductivity: the ability to conduct electricity or heat
conduction: the process by which heat or electricity passes through a material

.

1.5 Something went wrong

Some of the following sentences contain factual mistakes. Find and correct them.

a. Thermoplastics can be shaped and reshaped under heat and pressure.
b. Lead is a good conductor of electricity.
c. Steel is not very durable.
d. Cast iron is an elastic material.
e. Ceramics are extremely flammable.
f. The lower the carbon content of a steel the harder it is.
g. When a ductile material, e.g. aluminium is drawn, it retains its new shape.
h. Copper is an insulating material.
j. Rubber is a ductile material.

1.6 Make sentences using the words given.

a. Elastic / material / stretch / easy / pressure
b. Tensile strength / steel / not necessary / depend / carbon content
c. Properties / engineering materials / improve / add / certain elements
d. Chromium / use / make / steel / corrosion-resistant
e. Alloys / durable / pure metals

2 Reading about materials

2.1 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.

Some properties of engineering materials

1. Malleability, ductility, elasticity and durability

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.

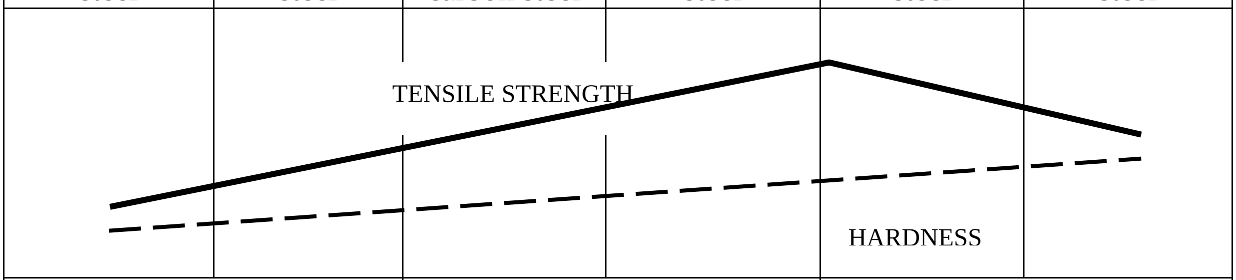
Elasticity: an elastic material stretches easily under stress. However, remove the stress and it does not retain its new form. Some steels are quite elastic. Glass is not at all elastic nor is cast iron.

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.

2. 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.

			High carbon steels		
low carbon steel	mild steel	medium carbon steel	hard steel	spring steel	tool steel



0.15	0.65	1.05

% CARBON →

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.

3. 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

4. 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

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).

2.2 Conductors, insulators and electron flow

2.2.1 Mark ten technical words in the next paragraph and define 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*.

Here are a few common examples of conductors and insulators:

- **Conductors:**
- silver
- copper
- gold
- aluminum
- iron
- steel
- brass
- bronze
- mercury
- graphite
- dirty water
- concrete

- **Insulators:**
- glass
- rubber
- oil
- asphalt
- fiberglass
- porcelain
- ceramic
- quartz
- (dry) cotton
- (dry) paper
- (dry) wood
- plastic
- air
- diamond
- pure water

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.

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)** aluminium 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*

2.3 Semiconductors

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.)*

Semiconductors

…class of crystalline solids intermediate in (1)____________________

between:

(2)____________ *transmit*

(3)____________ *control* *electric current*

(4)____________ *=belonging naturally*

(5)____________ *=coming from outside*

chemically (6)_________ crystals, e.g.

- silicon
- germanium
- gallium arsenide

DOPING
=adding small amounts of (7)____________________,
e.g. phosphorus

n-type:
impurity has an (8)___________ of negative charge

p-type:
impurity has a (9)___________ of negative charge

(10)____________ conductivity:
because
electrons are (11)____________
____

(12)____________ conductivity:
because
free electrons and empty spaces ("holes") from the (7)____________
help electricity to (13)____________

Expressing reason and consequence

Doping pure semiconductors **leads to** better conductivity .
Due to the little number of free electrons **there is** a worse conductivity.

Linking sentences and clauses to express cause and effect can be done in many ways. Try to find as many expressions as you can.

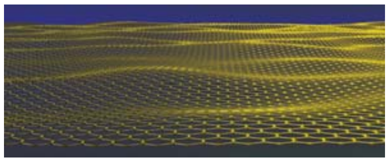
	reason		consequence
	Doping pure semiconductors	**causes**	better conductivity.
Because of	the doping of pure semiconductors		there is better conductivity.
	Pure semiconductors are doped.	**That's why**	there is better conductivity.
Because	pure semiconductors are doped		

	consequence		reason
	Better conductivity	**is caused by**	the doping of pure semiconductors.

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 ….

Scientists discover ground-breaking material



Graphene, which was discovered at the University 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 today (Friday 30 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

Vocabulary - to be completed by you

alloy	flammable	property
brittle	former … latter	proportion
cast iron	germanium	shell
ceramics	harden, hardening	tensile strength s
chromium	insulate, insulator	olid
concrete	integrated circuit	silicon
conduct, conductor,	intermediate	semiconductor
conductivity	malleable	respective
copper,	melting point	tungsten
corrode, corrosion	mercury	wear, resistance to wear
ductile regain	opaque	withstand
excess resist, resistance	oxidize	
ferrous, non-ferrous	pliable	

Testing your knowledge (materials)

1. Cast iron and steel are **a**________, a mixture of ________ and ________ .
2. Certain elements can improve the __________ of steel.
3. You add chromium to make steel more **c** __________ - ___________ and tungsten to increase hardness.
4. Plastics and _________ are non- _________.
5. Thermoplastics can be shaped by **h**_________ and **p** __________.
6. Aluminium does not ____________ .
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 ____________.
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 _________ .

easy to roll into a new shape	easy to draw, does not fracture, retains old shape	easy to stretch into a new shape under stress, does not retain new shape	does not corrode easily, long-lasting
withstands tension, strength not in proportion with carbon content	able to withstand abrasion, the higher carbon content, the better	not weighing very much, not heavy, also: opposite of dark	withstands heat
changes easily into gas	lets electricity pass through	allowing you to see through it	hardly allowing you to see through it
breaks easily	burns easily	firm and difficult to bend or move	not easily broken, torn, cut
solid, firm or stiff and difficult to bend or break	in the form of liquid, not a solid or gas	does not let electricity/ warmth pass through	causes rust and destroys sth slowly
stiff and difficult to bend or break	rough and can be used to clean a surface or make it smooth	can be decomposed in a biological process	soft and able to absorb water easily
changes shape easily when pressed, smooth, not having hard edges	withstands damage to surface by sharp objects	able to withstand the corrosion process	does not become thinner, smoother or weaker through continuous use or rubbing

Materials

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

Unit Seven   instruments and tools

Tools

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

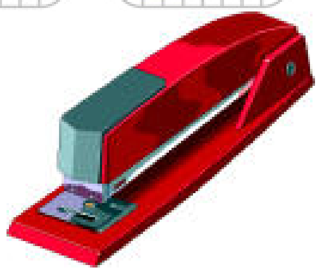
nail hammer, file, coffee machine, stapler, pair of scissors, chisel, pair of compasses, screwdriver, strainer, saw, pliers, square







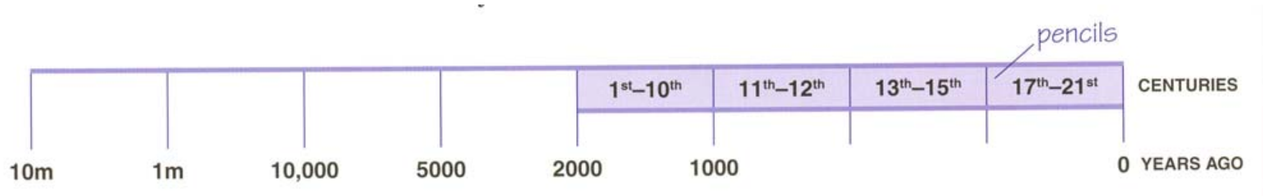


Technological change

1. Work in pairs. What are the 10 most important tools in the history of mankind? Make a list and put them in order of importance.
   Note: the tools must be *hand-held* or *easily portable.* Do not include *simple machines* (such as levers or pulleys), *heavy machine tools* (like hydraulic jacks) or *complex, self-running machines* (such as cars, windmills or computers).
2. Explain your list to the class. Give reasons for your group's choice.
3. Compare your list with the results of a survey. Do you agree? Give reasons.

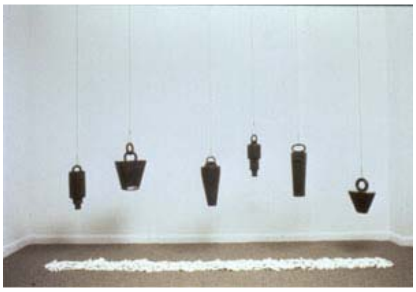
4. *Read this magazine article and mark the inventions on the timeline.*
Note: a century ends in its own number. The 14th century is 1301-1400.



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 of 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 12th century.
Glasses (or spectacles) make workers more productive and accurate, and allow people to work into old age. Mathematical calculations for a 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 the 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 a 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.

Do you know these? What are/ were they used for?

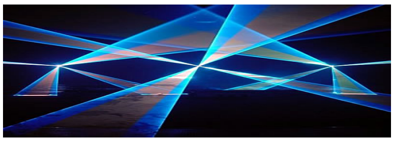




Complete the sentences with appropriate verbs

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

1. They ___________________________ a smoke alarm to the ceiling.
2. He ___________________________ his glasses with a handkerchief.
3. What skills are needed to ___________________________ this machinery?
4. He ___________________________ through the wall by mistake.
5. We ___________________________ away the top layer of the wall paper.
6. Stay well away from the helicopter when the blades start to ___________________________.
7. The hinges are ___________________________ _______________ of sheets of metal.
8. The metal had been ___________________________ flat.
9. It needs skills to ___________________________ a block of stone into a recognizable shape.
10. The label will ___________________________ off if you soak it in water.
11. The machine _________________________ a powerful beam at the affected part of the body.
12. I can't get the screw to ___________________________.
13. They used a special stone for ___________________________ knives.
14. You need a powerful saw to ___________________________ through metal.
15. It is difficult to ___________________________ diamonds.
16. Shapers ______________________ the cutting tool _________ ______________ ________ over the material.Presses are used to ___________________________ material against a hard surface.



Laser...

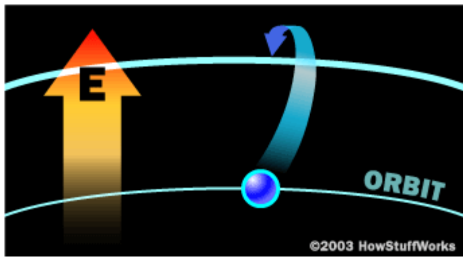
... a device that produces and amplifies light.

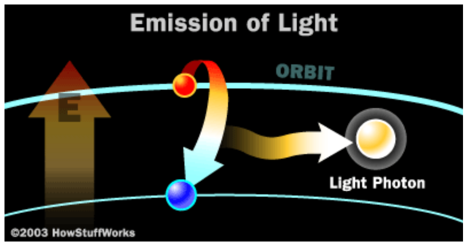
The word laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Laser light is very pure in color, can be extremely intense, and can be directed with great accuracy. Lasers are used in many modern technological devices including bar code readers, CD players, and laser printers. Lasers can generate light beyond the range visible to the human eye, from the infrared through the X-ray range. Masers are similar devices that produce and amplify microwaves.

PRINCIPLES OF OPERATION

Lasers generate light by storing energy in electrons inside atoms and then inducing the electrons to emit the absorbed energy as light. Light is composed of tiny packets of energy called photons.

Excited Atoms. Light Absorption and Emission





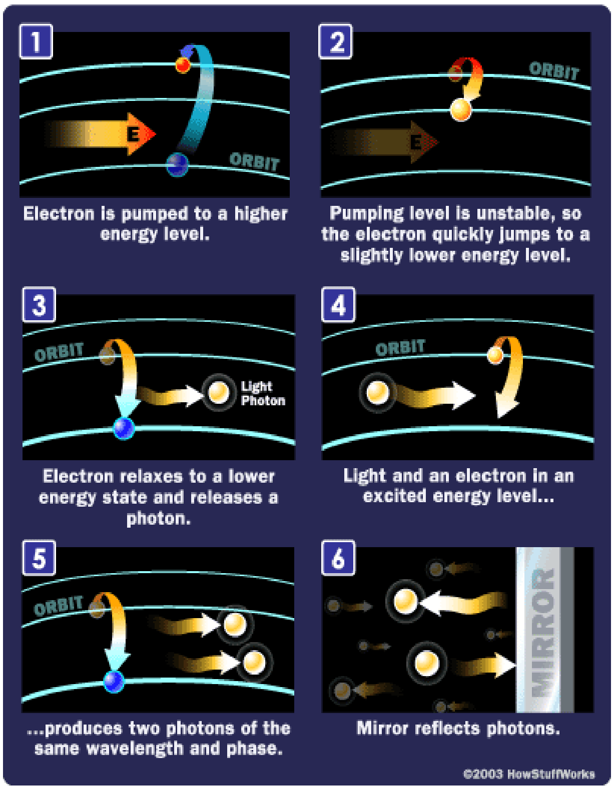
When a photon, or packet of light energy, is absorbed by an atom, the atom gains the energy of the photon, and one of the atom’s electrons may jump to a higher energy level. The atom is then said to be excited. When an electron of an excited atom falls to a lower energy level, the atom may emit the electron’s excess energy in the form of a photon. A photon’s energy, color, frequency, and wavelength are directly related: All photons of a given energy are the same color and have the same frequency and wavelength.
Usually, electrons quickly jump back to the low energy level, giving off the extra energy as light (Photoelectric Effect). Neon signs and fluorescent lamps glow with this kind of light as many electrons independently emit photons of different colors in all directions.

Stimulated Emission

Laser light has the following properties:
It is **monochromatic.** It contains one specific wavelength of light (one specific color). The wavelength of light is determined by the amount of energy released when the electron drops to a lower orbit.
It is **coherent**. It is “organized” -- each photon moves in step with the others. This means that all of the photons have wave fronts that launch in unison.
It is **directional**. A laser light has a very tight beam and is very strong and concentrated.

To make these three properties occur it takes something called **stimulated emission**.
The photon that any atom releases has a certain wavelength that is dependent on the energy difference between the excited state and the ground state. If this photon should encounter another atom that has an electron in the same excited state, stimulated emission can occur. The first photon can stimulate atomic emission such that the subsequent emitted photon (from the second atom) vibrates with the same frequency and direction as the incoming photon.
The other key to a laser is a pair of **mirrors**, one at each end of the lasing medium. Photons, with a very specific wavelength and phase, reflect off the mirrors to travel back and forth through the lasing medium. In the process, they stimulate other electrons to make the downward energy jump and can cause the emission of more photons of the same wavelength and phase. A cascade effect

occurs, and soon we have propagated many, many photons of the same wavelength and phase. The mirror at one end of the laser is "half-silvered," meaning it reflects some light and lets some light through. The light that makes it through is the laser light.



SOME TYPES OF LASERS

Lasers are generally classified according to the material, called the medium, they use to produce the laser light.
Solid-state lasers produce light by means of a solid medium. The most common solid laser media are rods of ruby crystals and neodymium-doped glasses and crystals. Solid-state lasers offer the highest power output. They are usually pulsed to generate a very brief burst of light useful for studying physical phenomena of very brief duration.

One method of exciting the atoms in lasers is to illuminate the solid laser material with higher-energy light than the laser produces. This procedure, called pumping, is achieved with brilliant strobe light from xenon flash tubes, arc lamps, or metal-vapor lamps.

The lasing medium of a **gas laser** can be a pure gas, a mixture of gases, or even metal vapor. Gas lasers can be pumped by ultraviolet light, electron beams, electric current, or chemical reactions. The helium-neon laser is known for its color purity and minimal beam spread. They are the most powerful continuous wave lasers—that is, lasers that emit light continuously rather than in pulses.
The most common **liquid laser** media are inorganic dyes contained in glass vessels. They are pumped by intense flash lamps in a pulse mode or by a separate gas laser in the continuous wave mode. Some dye lasers are tunable, meaning that the color of the laser light they emit can be adjusted with the help of a prism located inside the laser cavity.
Semiconductor lasers are the most compact lasers. Gallium arsenide is the most common semiconductor used. Scientists have developed extremely tiny semiconductor lasers, called quantum-dot vertical-cavity surface-emitting lasers. These lasers are so tiny that more than a million of them can fit on a chip the size of a fingernail. Common uses for semiconductor lasers include CD players and laser printers. Semiconductor lasers also form the heart of fiber-optics communication systems.
Free electron lasers employ an array of magnets to excite free electrons. First developed in 1977, they are now becoming important research instruments. The free electron laser facility at the University of California at Santa Barbara uses intense far-infrared light to investigate mutations in DNA molecules and to study the properties of semiconductor materials.

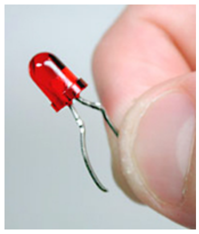
Answer these questions.
1. What does the acronym LASER mean?
2. What are the characteristics of laser light?
3. Explain the principle of light absorption and emission. Use the illustration.
4. What is stimulated emission? Use the illustration.
5. Which types of lasers are mentioned in the text? Name some of their properties.
6. Which applications of lasers do you know?

LEDs

A bright future (based on engine 2/2004, pp26-28)

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 LED 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.

Advantages of LEDs:

1. …
2. …
3. …
4. ...
5.

LEDs for the Olympics

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.

Product development engineers are pursuing several strategies to increase the light output of LEDs:

Chip materials: Optimized manufacturing processes will allow improved control of material properties and minimize material defects. Here, an important factor is the development of precision methods of doping the semiconductors with foreign atoms. When an electron and a hole recombine in an atom, light is emitted. But if the doping is imperfect, many electrons cannot contribute to the generation of light because they are captured by the "wrong" atoms. The quantum efficiency — the yield during the conversion of electrons into photons — presently ranges from 15 to 30 percent depending on the wavelength, and scientists are striving to increase that to somewhere near 50 percent.

Higher quantum efficiency would also reduce heat losses. Heat could cause problems in dense arrays of LEDs — for instance in car taillights. An accumulation of heat also lowers semiconductor efficiency, thus giving rise to a vicious circle.

Chip design: To the naked eye, small LEDs look like tiny cubes a few tenths of a millimetre in size. But under the microscope they prove to be much more intricate structures. Scientists are working with new shapes — some of them bizarre, like an inverted pyramid — to increase light output, That's because only a small portion of the light photons find their way out of the chip, since the semiconductor material has a high refractive index, sometimes above 3.0, which results in a higher proportion of total reflection at the boundary layers. Light that would otherwise strike the surface at a shallow angle is reflected back into the interior, where it is absorbed — much like light from a diver's lamp that is directed at a small angle against the water's surface.

Housing design: Other light losses occur at the boundary when using plastic sealing material. This material has a refractive index of 1.5— only about half that of the semiconductor. But the refractive indices should be as identical as possible to minimize total reflection. Even a small increase in the refractive index of the sealing material would greatly improve the proportion of emerging light.

If all works well, it should be possible in ten years to produce white LEDs that yield 100 lumens per watt (lm/W). Today's best LEDs manage 25 to 30 lm/W. By comparison, a 12 lm/W incandescent bulb with an efficiency of only five percent is merely a heating element that also emits a little light. Theoretically, the maximum yield in LEDs is as high as 200 lm/W. "The practical limit is probably somewhat lower," says Stath.

Power laser diodes are an especially hot development. What distinguishes these diodes is an optical resonator that greatly amplifies the intensity of the light. Osram already has laboratory models for infrared light — tiny rods measuring 1x10 millimeters — that can produce an optical output of 80 watts in continuous operation with an efficiency of 50 percent and must therefore be water-cooled. Continental Temic has used such pulse lasers in developing an automatic distance control system for automobiles that is less costly than radar-based versions. "You can also employ infrared lasers to illuminate the roadway and use a night-vision system to turn night into day," says Stath.

But Osram researchers won't settle for infrared light. They intend to use the extremely high light yield of power lasers for visible wavelengths, especially for blue and green light. If successful, these lasers could find widespread application in projection technology. This might, for instance, turn laser TV — once so highly touted, only to be pronounced dead — into a hot item after all. Small semiconductor lasers would take the place of large, costly solid-state lasers, paving the way for large screen projection television.

Strategies for the future (add some facts):

1. material development
2. new shapes
3. new housings
4. power laser diodes

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.

Features
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)

Giant knife 2007
The biggest Swiss Army knife ever produced. It contains no fewer than 87 tools offering 141 functions.

The Guinness World Records judges have just awarded it the title of “Most multifunctional penknife”.

Answer the questions:

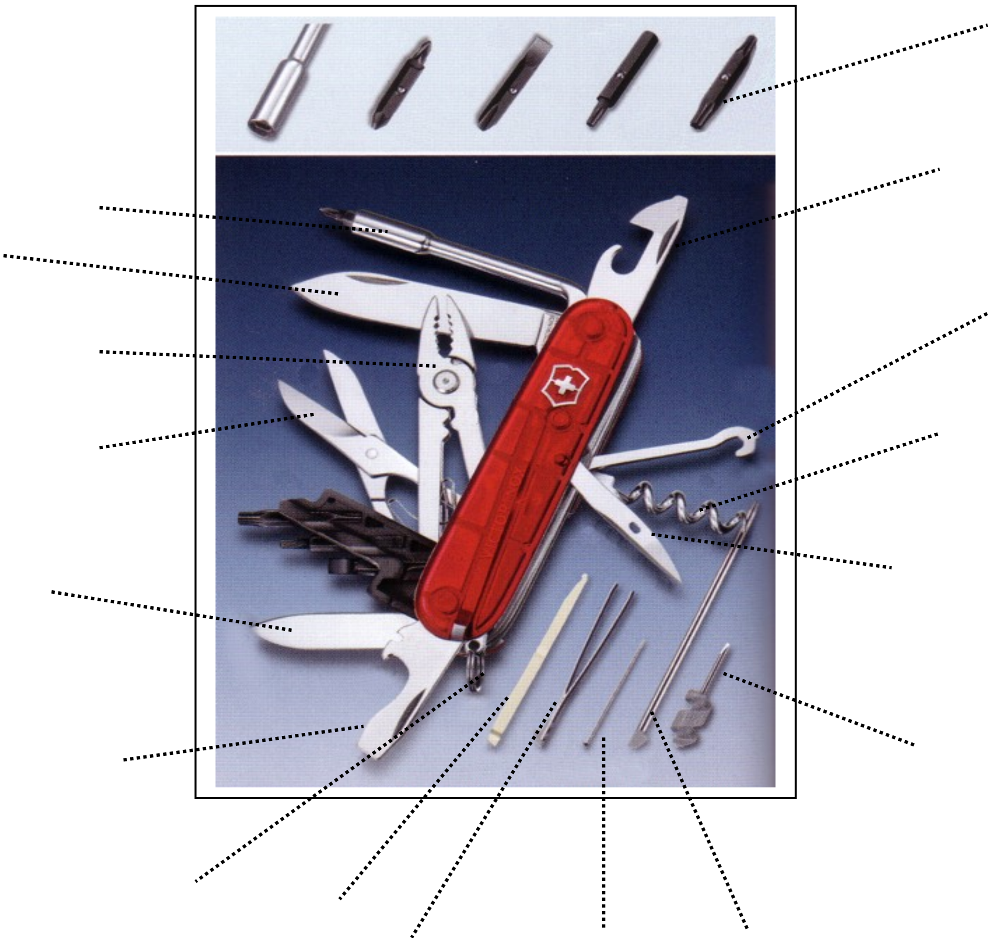
1. Where were pocket knives for the Swiss Army originally produced?
2. What did the so-called ‘Soldier’s knife’ consist of?
3. What was added by Elsener and what was an innovation at that time?
4. What is the difference between the Wenger and Victorinox knives?
5. Which company produces SAKs for the 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) phillips-head screwdriver
b) key chain/ring
c) tweezers
d) toothpick
e) altimeter

Name the different parts. Underline the parts which do not come with this model.

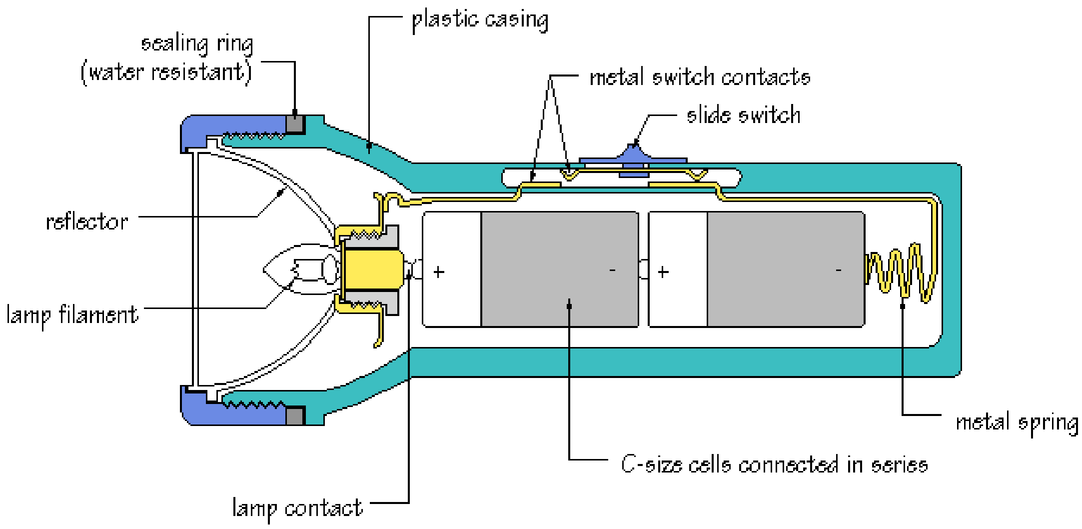
scissors, ruler, tin opener, magnifier, screwdriver, nail nick, bottle opener, fish scaler, file, cross-tip screwdriver, large blade, corkscrew, small blade, flat head screwdriver, awl/ reamer, keyring, ball point pen, pliers, tooth pick, tweezers, pin, hook, protection cap, top pieces



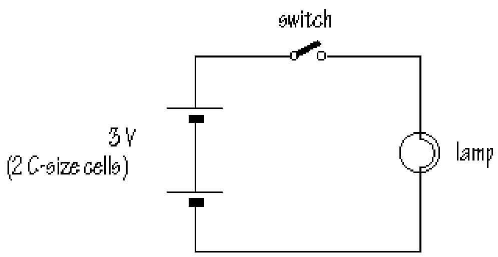
The Torch

Read the following text on Torch and be prepared to explain its electric feaures afterwards

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 known 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.

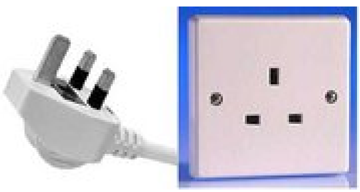
These plugs are required to carry a cartridge fuse, manufactured to BS 1362, which can be rated at 3, 5, 10 or 13 amperes. The maximum load that can be placed on a socket, including double and triple sockets, is 13 A. The double sockets are unfused, so it is possible to draw up to 26 A before hitting 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.

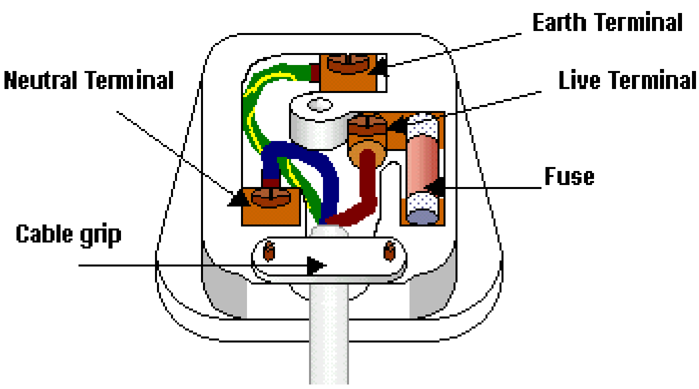
The plugs and sockets are designed to carry up to 250 volts AC, 50 hertz. The UK power system is officially 230 V +10% −6%. However, in reality, voltages are generally closer to 240 volts than 230, as the old standard before European harmonisation was 240 V ±6%, and most supplies installed to the old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





Taken and adapted from wikipedia.org

Explain:

- ➢ live pin
- ➢ neutral pin
- ➢ earth pin

What does the underlined sentence express?

a. There 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?

Listening

In this interview, Lisa Kaiser, a German expert on EU consumer affairs, is talking to Peter Bond of the British Standards Institute about introducing standardized plugs and sockets throughout the EU.

Complete the sentences with details from the interview.

1. The EU began discussions on a standard European __________ in __________ .
2. Brussels gave up the idea in _________ because some countries were not willing to give up __________ __________ __________ .
3. There is already a standard plug for small appliances like _________ and __________ that you can use everywhere except in the _________ .
4. This standard plug is a flat _________ - __________ plastic plug that is connected to the _________ at the ___________ .
5. It would cost _________ million euros to convert to a standard European plug for heavy appliances in __________ alone.
6. In the whole of the _________ , the costs would be __________ times the German amount.
7. Conversation would take at least __________ years.
8. Conversation would also create 600.000 tons of __________ and __________ waste.

(taken from: New Focus on Success)

A cathode-ray oscilloscope

Student A

Explain the underlined words to your neighbour and ask him/her for the missing words in your text. At the end you should have a complete text.

A cathode-ray oscilloscope is an electronic <u>display</u> 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 <u>variables</u>, 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 <u>converted</u> 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. <u>Speed</u> 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 <u>gun</u> and 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 <u>currents</u> 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 <u>lengths</u>, 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 <u>research</u>, television-production engineering, and electronics design.

Ask your neighbour 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?

A cathode-ray oscilloscope

Student B
Explain the underlined words to your neighbour and ask him/her for the missing words in your text. At the end you should have a complete text.

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 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.

Ask your neighbour the following questions:

d) What does a cathode-ray tube consist of and how does it work?
e) How are the graphs plotted on the screen?

instruments and tools

find the words and give definitions

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

____

____

________________________________ square

your favourite tool…

____

____

________________________________ ________________

Electrician’s tools and their usage

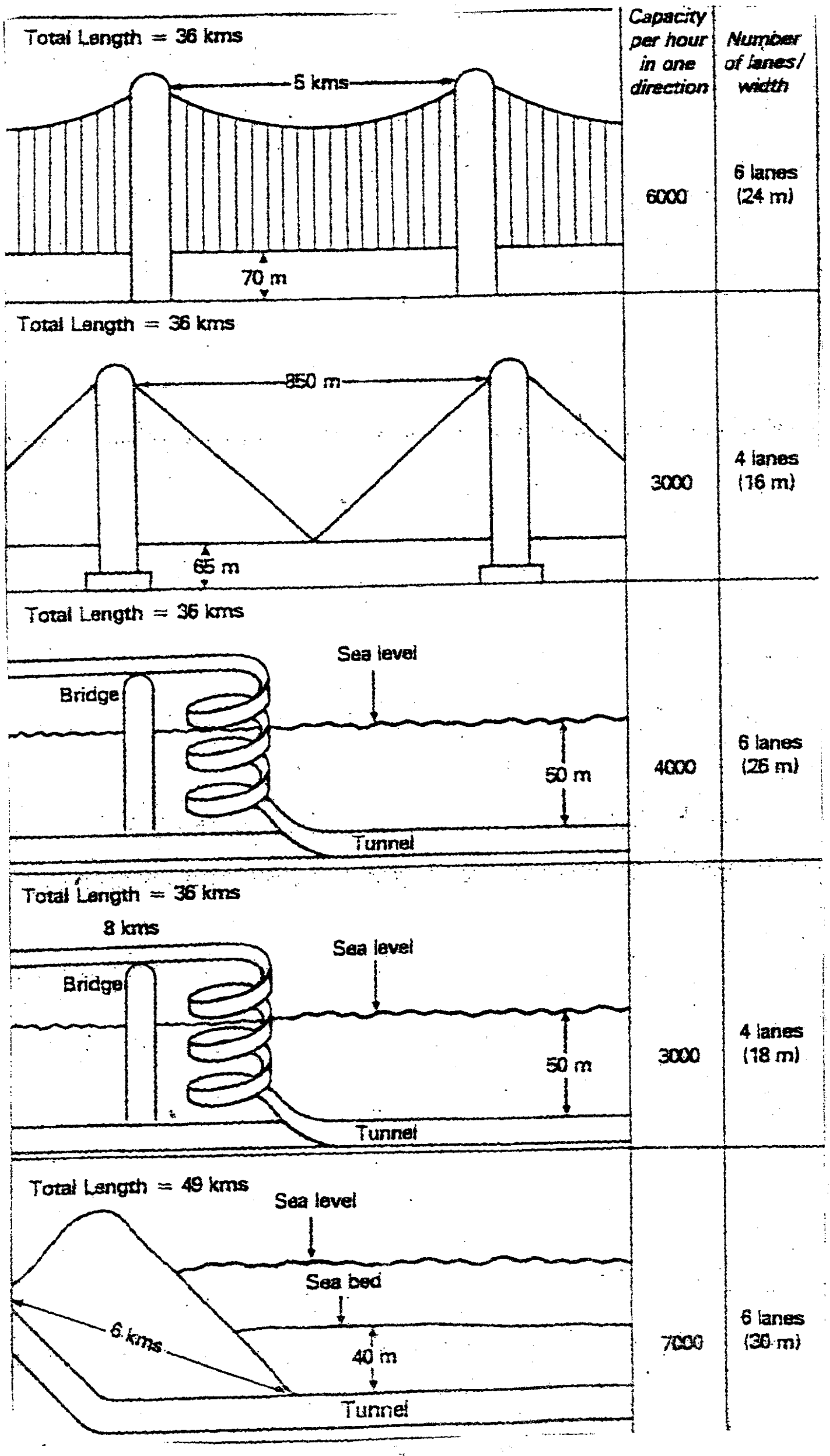
- mains tester or test lamp
- wire stripping and terminal crimping pliers with bolt cutter;
- electrical tape
- needle-nose pliers
- Lineman’s pliers (combination pliers)

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	

Unit Eight physical units and measurement

The Brunnel

The Brunnel project gives details of five plans to build a cross-channel link, either by a bridge, a tunnel or a bridge/tunnel. In the following presentation the speaker outlines the specifications for each proposed structure and, in particular for a bridge, considers the numbers of spans needed. Listen
[Technical Contacts, Brieger, Comfort, . Klett 1992]



Read the text of the presentation "The Brunnel project" and underline all words and phrases expressing dimensions.

Good morning, ladies and gentlemen.
We have received 5 plans for the "Brunnel project" from both local and foreign companies. As you will see from the diagrams the companies are split between 3 types of construction - a bridge link, a bridge/tunnel link and a tunnel link. This morning I would like to describe each of the plans briefly. Then we can have a fuller discussion about each proposal. You will then have time to consider each plan in detail and I suggest we meet for further discussions 2 weeks from now. For reasons of confidentiality, I will not give the names of the companies. Instead, I will simply call the plans number 1, number 2, number 3, number 4 and number 5.

To begin. As you can see from the diagrams, plan number 1 is for a construction 36 kilometres long, at a height of 65 metres above sea level. You will remember that in our specifications we stated a height of between 65 and 70 metres. It will consist of 48 spans, and each span will be 850 metres in length. It will carry passenger and goods vehicles on its 4 motorway lanes, and will be 16 metres wide in total. The company estimates that it will carry 6,000 cars per hour.

The second plan is for a combined structure. Here the tunnel will be at a depth of 50 metres below sea level. The bridge will be 8 kilometres long on each side with 8 spans. Each span will be 1 kilometre long. However, the total length of the structure will be the same as plan 1. The motorway will consist of four lanes for passenger and goods vehicles, and will be 18 metres in width. The construction company estimates that it will carry 3,000 cars per hour in one direction.

Moving on to plan number 3... If you look at your diagrams, you will see that the length of the planned structure is greater than the other constructions. The reason for this is that the entry and exit points will be approximately 6 kilometres inland on each side. However, with an estimated capacity of 14,000 vehicles per hour, it can carry much more traffic than its competitors.

The fourth plan is again 36 kilometres long. It will have 6 motorway lanes - one for slow-moving vehicles and the other two for overtaking - and will carry an estimated 6,000 vehicles per hour in one direction. In contrast with plan number 1 the structure will consist of only 7 spans, each 5 kilometres long. As you can see from your plans, it will be built at a height of 70 metres above sea level.

Our final plan, number 5 is very similar to number 2. The main differences are the width and the capacity. The advantage of the structure is that the company estimates that the motorway, which will be 26 metres wide, can carry a total of 8,000 vehicles per hour.

That concludes my brief description of the 5 plans and I suggest that we...

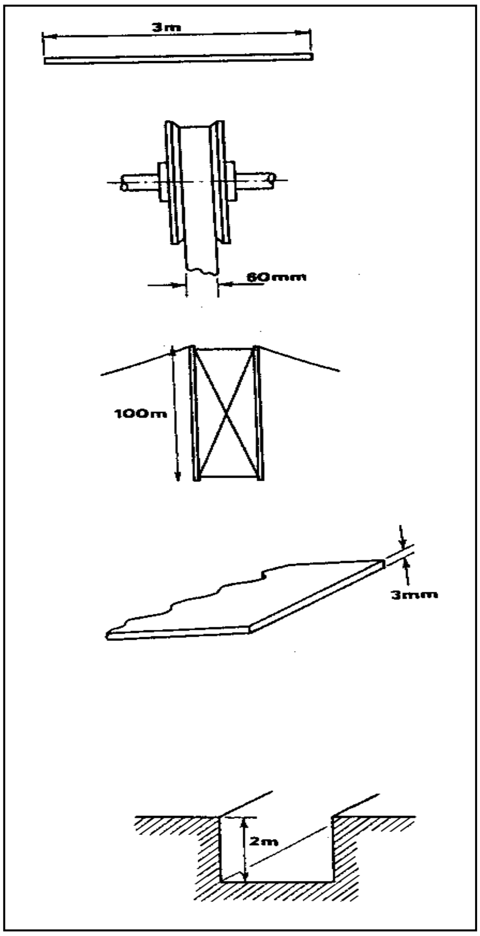
Physical units and dimensions

1. Basic metric units
2. Derived metric units
3. Compound metric units
4. Angles
5. Shapes/ figures

1. Basic metric units

Look at the pictures and complete the sentences using the words from the box.

high - depth - thickness - long - width/breadth - mass - wide/broad - height - length - thick - deep



a) The bar is three metres __________.
The bar is three metres in __________.
__________ of the bar is three metres.

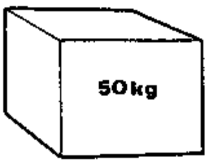
b) The belt is sixty millimetres __________.
The belt is sixty millimetres in __________.
__________ of the belt is sixty millimetres.

c) The tower is a hundred metres __________.
The tower is a hundred metres in __________.
__________ of the tower is a hundred metres.

d) The sheet is three millimetres __________.
The sheet has __________ of three millimetres.
__________of the sheet is three millimetres.

e) The trench is two metres __________.
The trench is two metres in __________.
The trench has __________ of two metres.

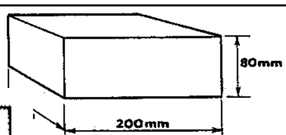
f) The block has __________ of fifty
__________ of the block is fifty kilogrammes.

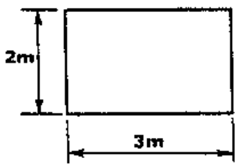


2. Derived metric units

Derived metric units are products of the basic units.

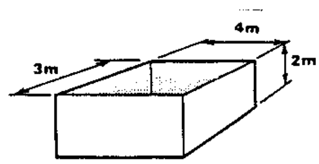
Complete the sentences. The first ones have been done for you.





The plate has an *area* of six square metres.
The *area* of the plate is six square metres.
The plate is six square metres *in area.*

The brick has a volume of 1,600 cubic centimetres.
____________________ is 1,600 cubic centimetres.
The brick is ________________________________.



The tank has a capacity of 24 cubic metres.
____________________ is 24 cubic metres.
The tank is ___________________________.

3. Compound metric units

Compound metric units are made up of basic and derived units of measurement.

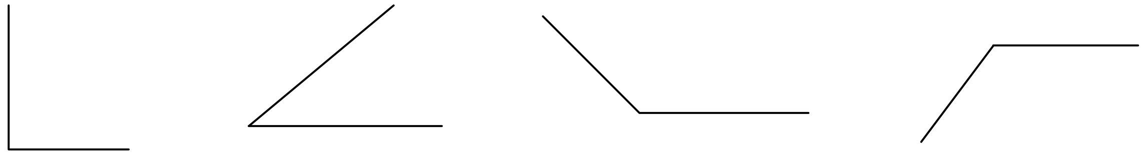
Match the corresponding parts.

1. Velocity is measured in metres per second.	A. It is found by dividing a force by an area.
2. Pressure is measured in Newtons per square metre.	B. It is found by dividing a distance by a time.
3. Density is measured in kilogrammes per cubic metre.	C. It is found by dividing velocity by a time.
4. Acceleration is measured in metres per second squared.	D. It is found by dividing a mass by a volume.

Write your own definition.

How do you measure voltage?
How do you measure resistance?

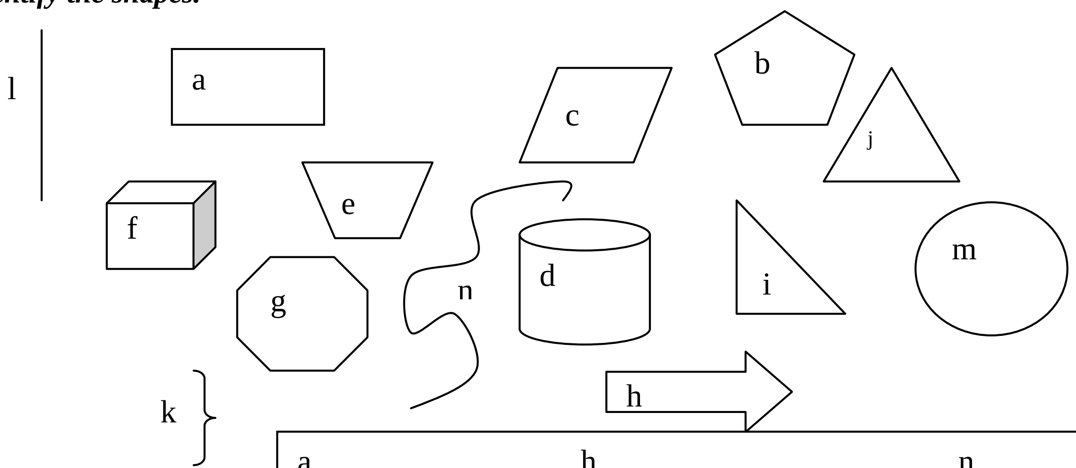
4. Angles



A *right* angle is 90°. Angle A is a right angle. An *acute* angle is less than 90°. Angle B is an acute angle. It is 45°. An *obtuse* angle is more than 90° but it is less than 180°. Angle C is an obtuse angle. It is 120°. A *reflex* angle is more than 180° but less than 360°. Angle D is a reflex angle. It is 210°.

5. Describing shapes

Identify the shapes.



a ____________ h ____________ n ________________

b ____________ i ____________

c ____________ j ____________ three-dimensional shapes:

d ____________ k ____________

e ____________ l ____________

Use the adjectives below to describe the shape of the following objects.

circular - conical - cubic - cylindrical - hexagonal - spherical - square - triangular

a. a chessboard
b. a disk
c. most warning signs for road traffic
d. a dice
e. a ball
f. a pipe
g. the unsharpened end of a pencil
h. the top of a rocket

Other useful words:
apex, base, circumference, diameter, distance, perpendicular to, radius

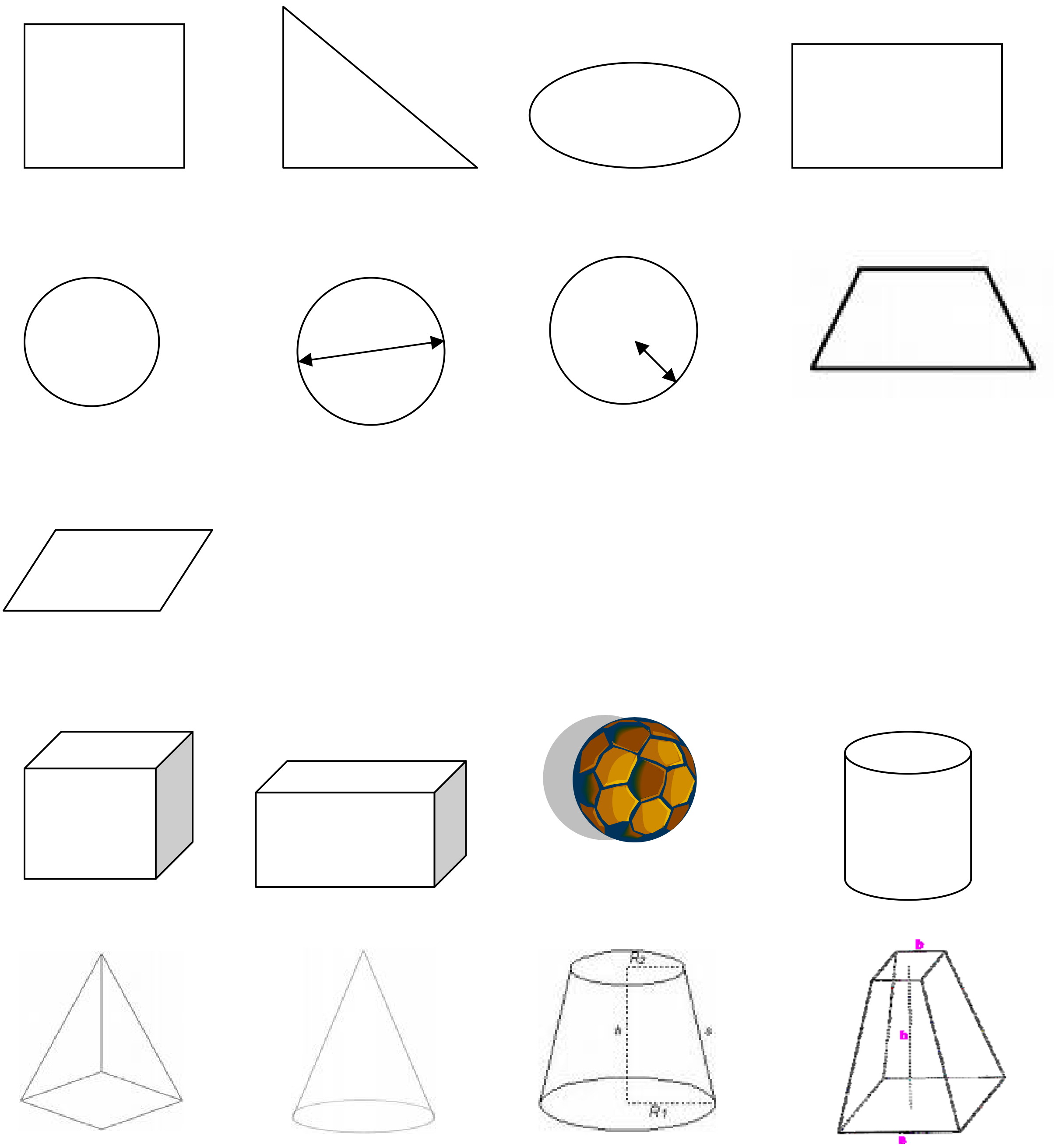
Use the words from the box to complete the descriptions. Which shapes are being described?

angles - apex - base - length - shape (2x) - sides - square - triangle - triangles - three-dimensional – width

a. This is a two-dimensional shape with four sides. The opposite pairs of sides and pairs of angles are equal. The angles are not right angles.
b. This is a two-dimensional _______________ with six ________________ that may or may not be of equal length.
c. This is a two-dimensional ________________. It has four sides of equal ________________. It has four ________________ which are all right angles.
d. This is a ________________ shape with six surfaces. The length, ________________ and depth of this shape are all equal.
e. This is a three-dimensional shape with only two surfaces. The ________________ is round. The outer surface rises from the edge of this to a single point, or ________________.
f. This is a three-dimensional shape with either four or five surfaces. The base can be ________________, with four sides, or a ________________, with three sides. The other surfaces are also ________________. They rise from the edges to the apex of the shape.

When describing objects, you need to know the names of geometric(al) shapes and figures. Match them with the corresponding terms.

pyramid . rectangle . triangle . rhombus . circle . cylinder . diameter .oval/ ellipse . radius . square . cube . cuboid . sphere . cone . trapezoid . frustum of cone/ pyramid



Shapes

Find 18 words describing shapes or dimensions

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	S	N	G	E	Y	R	E	C	T	A	N	G	L	E	O	U	N	I	R	A
2	X	C	I	R	C	U	M	F	E	R	E	N	C	E	I	Q	S	S	W	N
3	Q	A	T	G	I	W	G	R	P	E	R	I	M	E	T	E	R	D	S	T
4	S	P	T	J	R	W	E	H	R	F	N	S	C	N	O	K	I	Q	Y	X
5	I	K	V	U	X	N	N	T	O	S	P	H	E	R	E	M	C	Q	L	E
6	T	R	I	A	N	G	L	E	U	U	T	I	X	P	J	T	Q	X	Z	A
7	U	E	P	O	L	Y	G	O	N	N	R	K	C	Y	S	E	Z	E	C	U
8	I	P	M	G	D	A	L	I	H	D	D	J	B	R	O	V	O	S	U	M
9	E	R	N	J	X	N	P	T	L	S	I	P	M	A	Y	O	B	X	B	T
10	A	C	Z	G	V	Q	F	F	S	Q	M	T	K	M	X	L	T	P	E	Q
11	Y	U	R	Q	A	P	E	X	M	D	E	F	Y	I	T	U	U	A	G	V
12	O	E	P	U	Y	G	E	E	G	M	N	T	P	D	M	M	S	T	X	R
13	L	E	N	G	T	H	P	B	Y	M	S	D	N	W	I	E	E	R	A	K
14	M	B	F	R	V	V	Y	X	G	G	I	F	C	H	V	E	V	A	B	F
15	B	H	E	K	P	R	I	S	M	Y	O	B	O	R	K	V	U	P	G	Y
16	C	V	W	W	M	O	R	Z	T	C	N	C	G	X	W	G	S	E	Y	J
17	R	L	B	I	H	O	M	E	V	Q	J	I	P	E	S	H	I	Z	F	M
18	X	G	E	D	Q	C	P	G	B	J	I	T	K	I	B	L	M	I	A	E
19	M	S	P	T	E	D	I	F	O	D	C	K	C	O	N	E	H	U	V	W
20	Q	K	X	H	Y	O	H	E	X	A	G	O	N	B	U	K	K	M	P	N

Revision Vocabulary

Match the words in the left column to the best available answer in the right column.

1) acute angle	a) A= 4∏ x r2
2) congruent	b) C = 2∏ r
3) circle	c) A = s2
4) sphere	d) A = ½ x b x h
5) obtuse angle	e) distance across the circle
6) circumference	f) Its measurement is between 0º and 90º.
7) rectangle	g) Its measurement is exactly 90º.
8) square	h) A = ½ x h x (a+b)
9) right angle	i) Line segments that have the same length or angles that have the same measure.
10) trapezoid	j) pyramid with a circle base
11) triangle	k) A = b x h
12) parallelogram	l) distance around the circle
13) diameter	m) Its measurement is between 90º and 180º.
14) cone	n) A = l x w

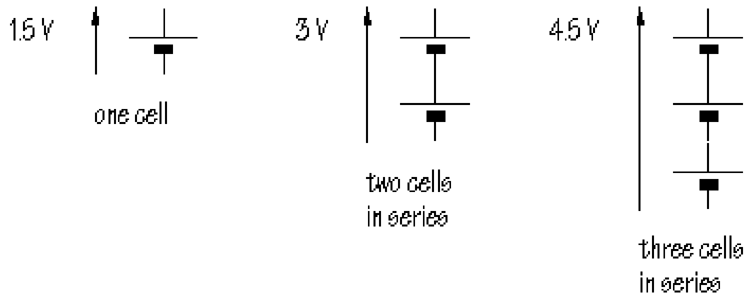
Electric quantities

Voltage

Fill in the missing words:

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

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:

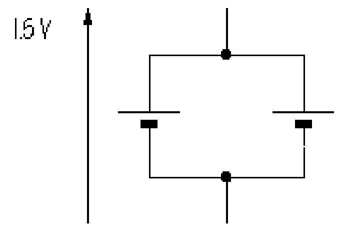


Cells connected in series

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 <u>current</u> for a long time, or a big current for a short time. Connecting the cells in series <u>increases</u> the voltage, but does not <u>affect</u> the useful life of the cells. On the other hand, if the cells are connected <u>in parallel</u>, the voltage stays at 1.5 V, but the life of the battery is <u>doubled</u>.
A torch lamp which uses 300 mA from C-size alkaline cells should operate for more than 20 hours before the cells are <u>exhausted</u>.

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.
The flow of current through the filament causes it to heat up and glow white hot. In air, the filament would quickly oxidise. 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:

Why is there a vacuum in the torch head?

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

Read the formula aloud.

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

Mark the correct version of the homonyms.

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

Unit Nine laboratories, experiments and safety

Visiting a laboratory

Describe what you can see in this photograph.

Listening:
A group of exchange students is being shown round the University of Applied Sciences. At the moment they are looking at one of the modern laboratories.

Listen to the guide and answer the following questions:

1. *What can you find in the laboratory?*
2. *What does the workplace look like?*

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

"Ladies and gentlemen,

I'm now going to show you our laboratories which we are especially proud of. At the moment we have more than twenty well-equipped labs, where our students can gain practical experience, where they can prepare for their future work in industry.

Let's first take a look into one of the labs of the electrical engineering department. This way, please.

This laboratory is laid out for sixteen students. The main space is taken by eight equally equipped workplaces.

This here in front of you is such a workplace. You can see the container on the right-hand side, can't you? In the upper drawer switches and bridges are stored. The students use them for connecting the elements of an electrical circuit. The plug-in board needed for such an experiment is placed above.

The device left of the plug-in board is a 20 MHz Dual Channel Oscilloscope. I suppose you know that an oscilloscope is an instrument which shows variations of current as a wavy line on the screen of a cathode ray tube (like a TV screen).

Now let me say something about the instruments right of the plug-in board. They are a capacitor, a coil and a resistor, all of them decadic adjustable.

Next to them is a big stop-watch, which is used for measuring time. For example, it is sometimes of great interest to find out how long a certain capacitor takes for charging up.

Directly at eye-level the mains supply circuit has been installed. Of course, the workplace is also equipped with the necessary sockets. The cables and plugs are fastened at the sides.

Finally, I'd like to show you the devices on the desk itself. This here is a slide resistor and that is a multimeter. This transformer is needed very often. It is an apparatus that increases or decreases the voltage of an electric power supply.

Well, if you look round you will notice that the room is furnished with several boards and chairs and, of course, with a workplace for the supervising lecturer, including his PC."

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.

Laboratory Guidelines

Read the following guidelines for laboratory sessions in physics at Exeter University.
Give each paragraph a heading from the box below.
Summarize each paragraph using your own words. Compare them with the guidelines that apply to your lab sessions.

assignments • assessment • intended learning outcome • feedback • duration • content

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%)

____

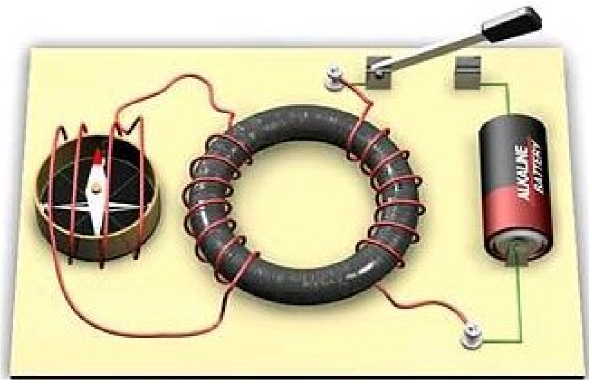
Experiments are marked by a demonstrator, during a 15-minute marking session with each student. Marks are given for general layout, demonstration of good experimental technique, analysis of the results and conclusions drawn.
All the marks, after moderation are added and a percentage derived which contributes 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.

____

Due to the interactive relationship between the students and demonstrators, feedback is continually provided at the initial discussion, during the execution of the experiment, in planning and assessing the report and during the final discussion. Marks for experiments are given and explained in the final discussion. The comments on the student's performance and the quality of their report are put in the individual student's card and are discussed with the students. *[University of Exeter Laboratory Guidelines]*

Experiment: Faraday's Magnetic Field Induction Experiment (Reporting)

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.

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.

Transform the following sentences into the passive.

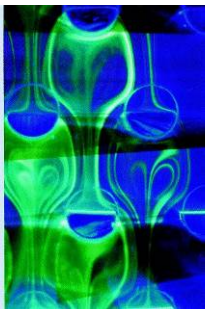
1. They are building a new factory here.
2. As far as possible they buy cheap land when they start such projects.
3. They have expanded the airport.
4. They are widening the main road to the harbour.
5. Last year they opened a new rail terminal.
6. A local company will provide the telecommunications technology.
7. They did not make any new suggestions.
8. Have they used this technique before?

Laser Technology

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.

1. *enormous • 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*

Laser-optical techniques allow[18] high-precision measurements[19] in a variety of applications: deformations and vibration of machine elements, non-destructive testing, as well as measuring velocities[20], temperatures and species concentrations in highly complex fluid[21] flows, just to name a few examples.

/www.physik.uni-oldenburg.de/EP/laser.htm

18. *enable • forgive • have*
19. *dimensions • means • data*
20. *bicycles • pressures • speeds*
21. *liquid • waters • vapours*

Insert the correct prepositions

How screens display colours
As discussed in the section above, what are colours?, a computer monitor is made up ________________**1)** thousands ________________**2)** tiny little red, green and blue dots which are grouped three and three. These little dots are close together - so close that we don't really see them as dots, but rather our eyes mix them up ________________**3)** form one homogenous colour.
All colours in the spectrum can be generated ________________**4)** this system ________________**5)** dots. For instance, if the red and green dots are shining ________________**6)** 100% their strength, while the blue not lit ________________**7)** all, you will see the result as a pure yellow colour. Each ________________**8)** the three dots can have any value ________________**9)** 0 ________________**10)** 255, which means that the total number ________________**11)** possible colours is 256*256*256 = 16,777,216.

Any colour can be represented by a specific combination ________________**12)** three numbers. The yellow mentioned before would have the number 255, 255, 0. The first number represents the red dot, the second represents the green dot, and the last represents the blue. Therefore, a pure blue colour would then be 0, 0, 255. The lower the number, the less that color dot is lighted. For instance, by lowering the number for the blue dot - ________________**13)** the colour identified as 0, 0, 100 - you can produce a darker blue. White is produced by the combination ________________**14)** the highest amount ________________**15)** all three colours, so the code for white is 255, 255, 255. Black, on the other hand, is produced by a lack ________________**16)** other colours, so the code for black is 0, 0, 0.

Now to complicate things a bit more, on the web you don't write these numbers just as they are, but instead you write what is called their hexadecimal values. This can be a bit tricky to grasp, so I will try to explain it a bit more in detail.

Safety at the workplace

In laboratories you can see the following signs. Can you explain their meaning?

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.

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.

Instruction and warning signs

Explain their meaning in English.

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____
8. ____
9. ____
10. ____
11. ____

Modals

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.

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

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.)

Listening comprehension

Electric Fields: Mapping of force ***fields*** *(DVD Physics Demonstrations in electricity and magnetism, Physics Curriculum and Instruction, Lakeville, 1993)*

- *List the devices used and note the experimental set-up.*
- *Describe the experiment of one used object.*
- *When was the idea of an electric field first developed? By whom?*
- *Complete with a suitable word:*

The strength of an electric field can be ____________ (1) by the spacing between field lines. Near a ___________ (2) object, where the field is strongest, the lines are close together. As the distance from the charges ___________ (3) , the lines are farther apart, _________ (4) a decrease in field strength. Based on Faraday's ________- (5) , the lines of force continue on into the deepest reaches of space.

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 ___________________ in ___________
	- __________________________ 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?

Joule, James Prescott (1818-1889) and **Kelvin**, William Thomson, 1st Baron (1824-1907) – The Discovery of Energy

1. Fill in the appropriate years or time intervals or other expressions:

_____________ two French scientists invented the ice calorimeter

_____________ Lord Rumford carried out an experiment with cannon barrels

_____________ Joule was born near Manchester

_____________ Joule's law was established

_____________ Thomson was made professor at the University of Glasgow

_____________ Carnot had published his theory of the steam engine

_____________ Joule and Thomson worked on experiments concerning the cooling effect

_____________ Carl von Linde applied the J-T effect

_____________ Joule died in Manchester

_____________ Thomson was knighted

_____________ received title Baron Kelvin/ Lord Kelvin

_____________ Thomson died

_____________ unit of energy was renamed to honour Joule

2. Find 15 hidden words connected with the topic above.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	T	P	T	B	E	N	E	R	G	Y	V	Q	C	S	M
2	T	A	C	P	I	S	L	N	F	E	C	J	U	B	A
3	T	R	F	H	P	V	E	N	D	U	E	G	R	D	G
4	Q	T	J	A	R	D	C	S	W	M	N	H	R	G	N
5	O	I	H	I	E	M	T	F	W	T	G	G	E	M	E
6	P	C	O	N	S	E	R	V	A	T	I	O	N	R	T
7	W	L	R	D	S	A	I	E	T	L	N	F	T	R	I
8	O	E	J	Y	U	B	C	X	E	R	E	E	K	K	S
9	G	S	H	G	R	V	I	F	R	B	P	O	J	P	M
10	K	M	P	Y	E	R	T	X	O	V	F	J	O	W	O
11	E	T	M	P	E	N	Y	M	C	I	R	C	U	I	T
12	L	S	W	O	R	K	C	P	G	B	V	J	L	Q	J
13	V	S	W	W	T	I	O	B	W	M	B	K	E	E	L
14	I	N	R	E	S	I	S	T	A	N	C	E	R	X	P
15	N	P	D	R	N	S	Q	T	I	W	Y	S	M	M	G

3. Complete the following text using these words.

air conditioning systems • circuit • common refrigeration • current • determined • equal • expands • falls • metric • physicist • physicist • resistance • thermodynamics

The British ______________**1)** James Joule is best known for his work in electricity and ___________________**2)** (the study of heat). Joule discovered the relationship between electrical ____________**3)**, electrical _______________**4)**, and heat released by an electrical ____________**5)**. The ___________**6)** system unit of energy is the joule (J), after James Joule. Using many independent methods, Joule _______________**7)** the numerical relation between heat and mechanical energy, or the mechanical equivalent of heat. The unit of energy called the joule is named after him; it is __________**8)** to 1 watt-second, or about 0.000948 British thermal unit. Together with the ______________**9)** William Thomson (later Baron Kelvin), Joule found that the temperature of a gas __________**10)** when it ____________**11)** without doing any work. This principle, which became known as the Joule-Thomson effect, underlies the operation of _________________________**12)** and _____________________________**13)**.

Alessandro Volta and the battery

Alessandro Volta was born on…
18 February 1754 in Pavia (Italy)
8 February 1745 in Como (Italy)
18 February 1745 in Como (Italy)

When Volta was a child, the phenomenon of electricity…
had been unknown
as such was familiar
caused amazement among people

The electrophorus is a…
device that could generate high potential differences
device that generated electricity by friction
both a +b

Galvani did experiments…
with spiders
with frog legs
with insects

Volta discovered that liquids and bodily fluids…
act as conductors
act as insulators
created electrical current

Volta's voltaic pile consisted of…
a metal stamp and a cake of resin
copper coins, plates of zinc, leather disks soaked in brine
two metals and his tongue

Volta showed the voltaic effect with…
Galvani's frog experiment
the electrophorus
the voltaic pile

In 1810 Napoleon…
honoured him with a medal
made him count and senator in Italy
knighted him

Volta died….
in 1827
at the age of 80 in Como
in 1825

The physical unit volt…
was introduced 4 years after Volta's death
was introduced in 1815
was introduced at the first international electrical congress

accept • conductor • current • device • device • electrolyte • electrolyte • in series • producing

---

A Battery, also called electric cell, is a ___________**1)** that converts chemical energy into electricity. Strictly speaking, a battery consists of two or more cells connected ______________**2)** or parallel, but the term is also used for single cells. All cells consist of a liquid, paste, or solid ________________**3)** and a positive electrode, and a negative electrode. The ________________**4)** is an ionic ______________**5)**; one of the electrodes will react, ______________**6)** electrons, while the other will ___________**7)** electrons. When the electrodes are connected to a ___________**8)** to be powered, called a load, an electrical ____________**9)** flows.

The Pyramids *(Great moments in science and technology)*

1st viewing:

Which pyramid
1. is ideally located according to religious belief ?
2. appears to be higher than it actually is?
3. slopes at different angles?
4. was built using machines?
5. has a ground plan that is not square?
6. was built taking into consideration a problem that had been encountered earlier?
7. was the last one built as a grave?
8. was built on an originally uneven surface?
9. has been damaged over the centuries?

Pyramid of Djoser in Sakkara
Pyramid of Snofru in Meidun
Bent Pyramid
Red Pyramid
Pyramid of Cheops
Pyramid of Chephren
Pyramid of Menkeure

2nd viewing: *What do these figures refer to? Give as much detail as you can.*

1. 60 metres
2. 92 metres
3. 144 metres
4. 23 years
5. 3 minutes of arc
6. 2.1 cm
7. 2.8 million cubic metres
8. 2.3 million
9. 1 cubic metre
10. 2.5 tons
11. 20 years
12. 100,000
13. 3,500 workers
14. 20,000 men
15. 150 metres
16. 19th century
17. 30 metres
18. 25-50 tons
19. 66 metres
20. 21 metres
21. 110 metres

According to the Horizon theory, how was the orientation of the Pyramid of Cheops determined?

Listening comprehension: **The Meter Stick** (from: engine 04/07)

Historical *International Prototype Meter* bar, made of an alloy of platinum and iridium, that was the standard from 1889 to 1960.

Part I

1. What is the difference between meters and yards?
2. How were English and metric time determined?
3. When was the metric system introduced?
4. What do you need to use the metric system?
5. What did the two astronomers Delambre and Méchain determine?
6. Why was Méchain not satisfied?

Part II

Fill in the missing words.

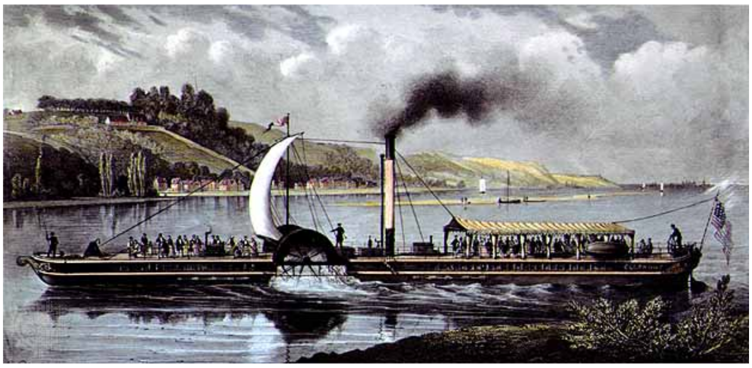
For years, Méchain kept trying to get (1)______________________________ results. He told only Delambre about the problem. Finally, after Méchain died of Malaria in Valencia, Delambre realised what Méchain had not. Earth is not a perfect (2)______________________________. The data would always be flawed. He published the results, but sealed the fact that Méchain had been covering up (3)______________________________. By then, the method of least squares had been created to get information from scattered results, and Delambre used it to get a best (4)___________________________ from Méchain's data. We now know that it takes ten million, plus another two thousand, of those meters to get from pole to equator. The standard platinum meter is short by about twice the (5)_______________ of paper. Today we define the meter as the distance (6)______________________________ travels in a certain small (7)______________________________ of a second. That doesn't match any pole-to-equator distance, for there is no such consistent distance. Rather, it simply reflects Delambre's and Méchain's two-century-old flawed (8)______________________________. And the standard meter remains as arbitrary as the distance from my nose to my outstretched fingers.

Final question

Why does the standard meter remain arbitrary?

Translate into English.

Wie lang ist ein Meter? Der Kampf um das Urmeter war lang und nicht frei von persönlichen Querelen. Dennoch ist das Urmeter zu kurz.



Inventing Speed *(from engine 11/06)*

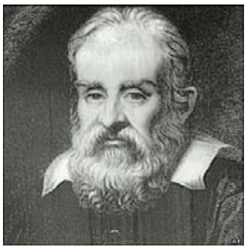
Decide whether the statements are true or false and correct the false ones.

1. A Stanley Steamer had a speed of 250mph.
2. At the beginning of the 19th century the horse was a symbol of speed.
3. After Robert Fulton had used a commercial Watt engine for a boat, steam driven cars were built.
4. In 1807 Fulton demonstrated his first steamboat.
5. The invention of speed inspired many artists.

Note:

Fulton, Robert (1765-1815), American inventor and engineer, who designed the first efficient steamboat.

Galileo Galilei



All groups

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?
4. Why did he get into conflict with the church?

Group 1

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 2

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?

Group 3

1. How much did his first prototype telescope magnify?
2. What could he discover with his telescope?
3. What did he write in his “Starry Messenger”?