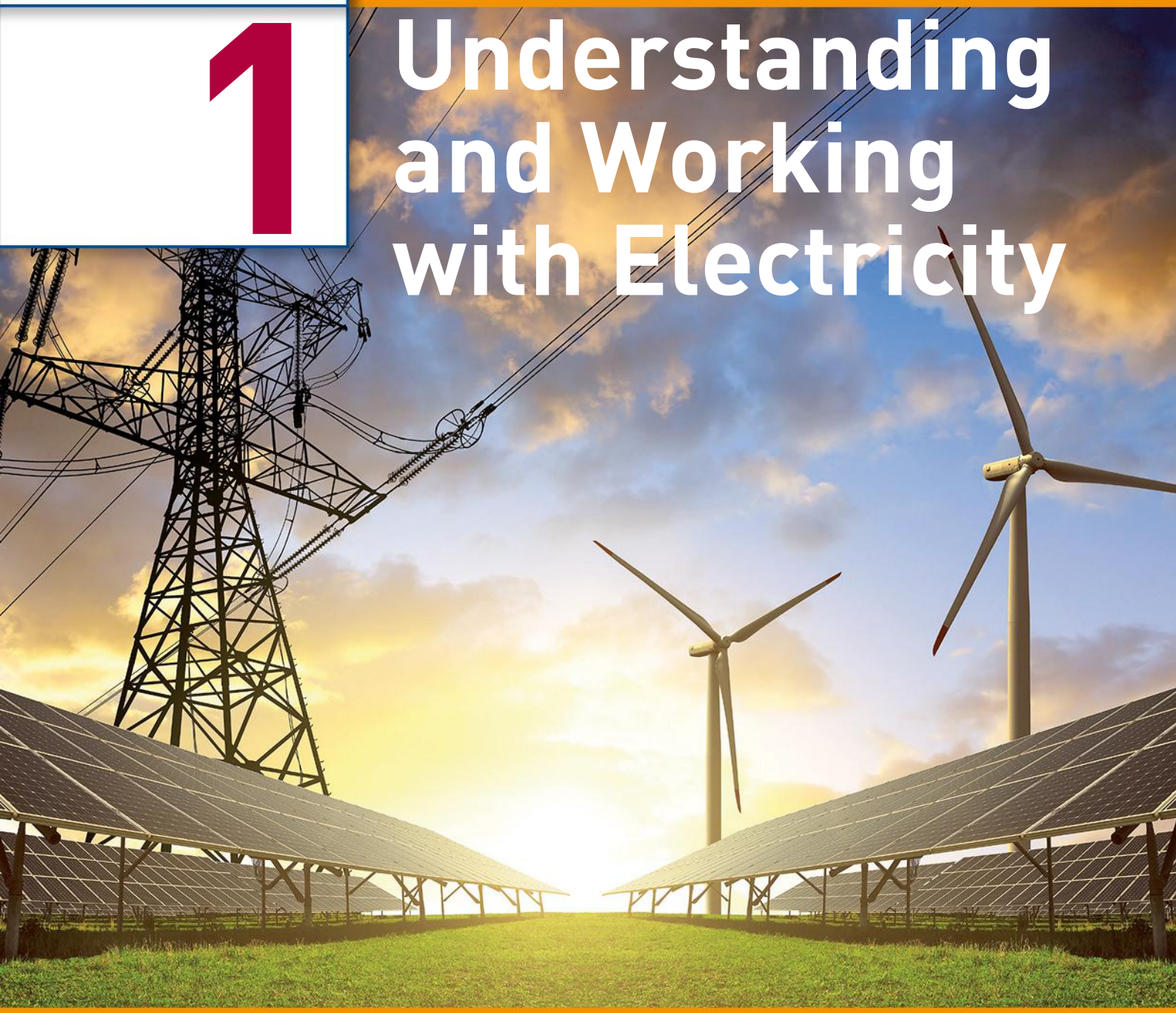
Module

# 1

# Understanding and Working with Electricity



The discovery of electricity has transformed the world in every possible way. This phenomenon, which is mostly taken for granted, has had a huge impact on people's life styles. Most, if not all, modern scientific discoveries are indebted to the advent of electricity. It is of no surprise that science and engineering students from diverse disciplines are required to take courses related to this subject.

No electrical installation can be carried out without a basic understanding of the fundamental concepts of electricity and electrical networks.

- At the end of this module you will be given an assignment related to an electrical installation.
- The texts and the exercises contained in the units will provide you with most of the information and the lexicon needed to carry out that assignment successfully.
- So, pay attention to what you find in the following units because it will prove very useful later on!

# Unit 1 Just What Is Electricity?

## Knowledge
- The basics of electricity
- Conductors and insulators

## Skills
- Understanding types and components of electrical circuits
- Describing an electrical circuit
- Discussing a statement about the importance of scientific discoveries
- Researching inventors who contributed to the history of electricity

## Competences
- Making an electrical design plan

## Warm up

**1. Fill in the grid.**

1. Write in the first column four electrical devices that you use on a daily basis.
2. In the second and third columns evaluate each of them on a scale from 1 to 10 in terms of usefulness and frequency of use. For example, a device that you consider very useful will be graded 8, 9 or 10.
3. When you have filled in the grid, compare your answers with those of your classmates.

**What do you conclude from what you have written?**

| Device | Usefulness (1-10) | Usage frequency (1-10) | Total |
|---|---|---|---|
| 1 ..... | ..... | ..... | ..... |
| 2 ..... | ..... | ..... | ..... |
| 3 ..... | ..... | ..... | ..... |
| 4 ..... | ..... | ..... | ..... |

**2. > Pair work < Can you find adjectives and verbs that are associated with the words "electricity" and "current"? Use a collocation dictionary for help. When you have finished, compare the terms you have found with those of your classmates.**

| | Adjectives | Verbs |
|---|---|---|
| Electricity | | |
| Current | | |

# A Basics of Electricity

**Glossary**

**lightning:** the occurrence of a natural electrical discharge of very short duration and high voltage between a cloud and the ground or within a cloud, accompanied by a bright flash

**conductor:** a material through which electrical current can pass

**funnel:** a tube or pipe that is wide at the top and narrow at the bottom, used for guiding liquid or powder into a small opening

**tapered:** becoming narrower at one end

▲ Lightning

▲ A funnel

Humans have established an intimate relationship with electricity and its applications, to the point where separating our activities from it has virtually become impossible. Electricity is what powers our world.

**a.** .....

Electricity is a form of energy that is associated with the presence and flow of electrical charges. The effects of electricity can be seen in many forms that include: **lightning**, static electricity, electromagnetic induction and electrical current. The communication technology industry uses electricity in the transmission and reception of electromagnetic radiation such as radio waves.

**b.** .....

All matter is made of atoms. These atoms consist of positive charges known as **protons**, negative charges known as **electrons** and **neutrons** which have no charge at all.

**c.** .....

Electrical current is the movement of free electrons from one atom to another. The movement of electrons is measured in **amperes** or **amps**.

**d.** .....

The flow of electrons is caused by an invisible force, known as **voltage**, which is measured in **volts**. The amount of current that can be moved is dependent on the **resistance**. The resistance of the **conductor** determines the amount of current that flows under a given voltage. In general, the greater the circuit resistance, the less the current. If the resistance is reduced, then the current will increase.

This can be illustrated by using the example of a **funnel**. As water is poured into the top of the funnel it is pushed downwards (voltage), but the flow of water (current) is slowed down due to the **tapered** section (resistance) on the bottom of the funnel.

**e.** .....

For example, just as the three primary colours (blue, red and yellow) can create any colour, there are three fundamental parameters in electrical engineering that all other parameters can be derived from: voltage, current and resistance.

Expressed in a formula: $\text{Voltage} = \text{Current} \cdot \text{Resistance}$ $(V = I \cdot R)$

| Parameter | Unit of measurement | Symbol |
|---|---|---|
| Voltage | volts | V |
| Current | amps | I |
| Resistance | ohms | Ω |

**f.** .....

Each unit of measurement is named after a famous scientist: the *amp* after the Frenchman André-Marie Ampère, the *volt* after the Italian Alessandro Volta, and the *ohm* after the German Georg Ohm.

(Adapted from Saric Mladen, *The Little Book of Big Understanding: Electrical Engineering Simplified*, Kindle Publishing, 2016)

## Understanding the text

**3.** **Read the text and give each paragraph a suitable title. Choose from the following.**

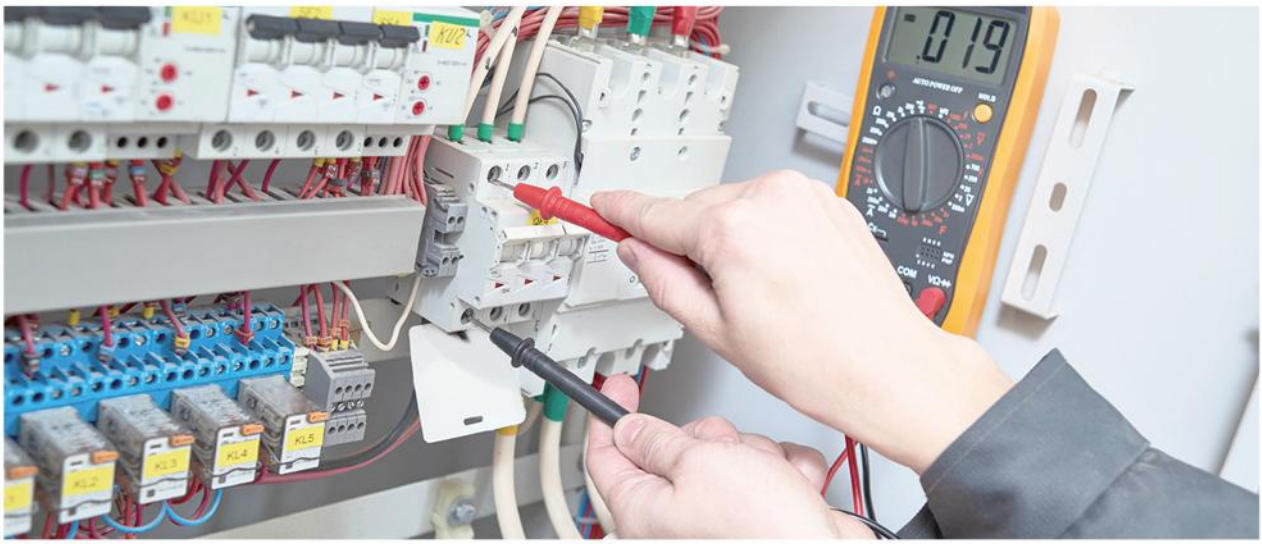
1. Everything Starts with Atoms
2. What Is Electricity?
3. Primary Colours and Electrical Engineering
4. How does Electrical Current Flow?
5. Where do the Names of the Units of Measurement Come from?
6. What is Electrical Current?

**4.** **Find terms and adjectives in the text that are associated with the following words. One has been done as an example.**

| | | |
|---|---|---|
| 1. | *static* | electricity |
| 2. | ..... | induction |
| 3. | ..... | current |
| 4. | ..... | industry |
| 5. | ..... | radiation |
| 6. | ....., ....., ..... | charge |
| 7. | ..... | electrons |
| 8. | ..... | parameters |
| 9. | ..... | engineering |
| 10. | ..... | scientist |

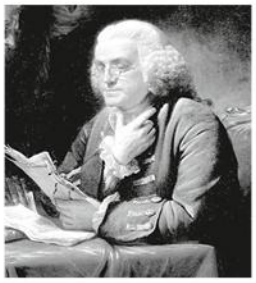
**5.** **Answer the following questions. Use some of the word associations from the previous exercise.**

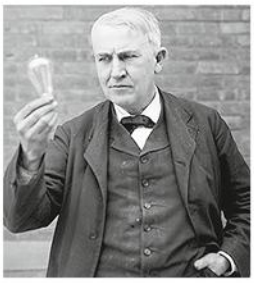
1. Where can the effects of electricity be seen?
2. What are atoms made up of?
3. What is an electrical current?
4. What causes the flow of electrons?
5. Which element determines the amount of current that can be moved?
6. In what way are voltage, current and resistance considered?
7. Who are the units of measurement named after?

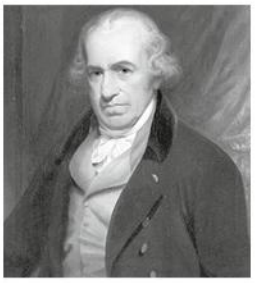


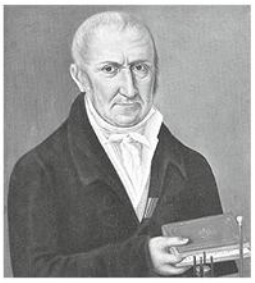
## Investigate!

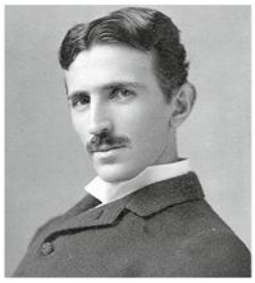
**6.** **Many inventors greatly contributed to the history of electricity. These include Benjamin Franklin, Thomas Edison, James Watt, Alessandro Volta and Nikola Tesla. Investigate two of them. Complete the two forms below.**


▲ Benjamin Franklin


▲ Thomas Edison


▲ James Watt


▲ Alessandro Volta


▲ Nikola Tesla

**1**

Name: .....

Place and date of birth: .....

.....

Main contributions, discoveries and inventions:

.....

Other interesting facts or information: .....

.....

.....

**2**

Name: .....

Place and date of birth: .....

.....

Main contributions, discoveries and inventions:

.....

Other interesting facts or information: .....

.....

.....

## Open discussion

**7.** **> Pair work < The inventors you have investigated made important scientific discoveries that greatly affected our everyday lives.**

1. How do you think they felt when they made their discoveries?
2. What do you think may be the pros and cons of being a famous inventor?
3. Would you like to invent something? Why?

INTERESTING FACTS

### WHERE DOES THE WORD "ELECTRICITY" COME FROM?


▲ Amber

The word "electricity" comes from the Greek term "electron" which means amber (a fossil resin from a type of coniferous tree). The Greeks noticed its power to attract small bits of ash when rubbed with cloth.

This accounts for the particular role of amber. In ancient times it was carried by travellers for protection and in the Far East it is the symbol of courage. Asian cultures regard amber as the "soul of the tiger". Egyptians placed a piece of amber in the casket of a loved one who had died, to ensure that the body would remain whole forever.

Early physicians would prescribe amber for headaches, heart problems, arthritis and other health issues.

# B Electrical Conductors and Insulators

**Glossary**

**tiny:** very small
**utility line:** cables, lines or wires for the transmission of electrical energy

Read more about: **What is Static Electricity?**

## Electrical Conductors

Some materials let electricity pass through them easily. These materials are known as electrical conductors. We define an electrical conductor as a substance in which the electrons can move with ease.

Pure elemental silver is the best known conductor at room temperature.

Copper, iron, steel and aluminium are good electrical conductors, too. This is why the parts of electrical objects that need to let electricity pass through them are always made of metal.

Metal, for instance, is used in plugs to allow electricity to transfer from the wall socket, through the plug and into a device such as a lamp or TV.

## Electrical Insulators

Some materials do not allow electricity to pass through them. These are known as electrical insulators. An electric insulator prevents electron movement among atoms, except occasionally in **tiny** amounts.

Plastic, wood and glass are good electrical insulators, that is why they are used to cover materials that carry electricity.

Engineers commonly use porcelain or glass in electrical systems. These devices (called insulators in the passive rather than the active sense) are manufactured in various shapes and sizes for different applications. You can see them on **utility lines** that carry high voltage.

(Adapted from Stan Gibilisco, *Teach Yourself Electricity and Electronics*, McGraw-Hill Education, 2016)

## Understanding the text

**8. Translate the following terms with the help of your dictionary.**

| | | | |
|---|---|---|---|
| **1.** silver ..... | **3.** iron ..... | **5.** glass ..... | **7.** porcelain ..... |
| **2.** copper ..... | **4.** steel ..... | **6.** wood ..... | **8.** plastic ..... |

**9. Answer the following questions.**

**1.** What is the difference between electrical conductors and electrical insulators?

.....

**2.** Why are some parts of electrical objects made of metal?

.....

**3.** Where are insulators used?

.....

**4.** List four conductors and four insulators.

| Electrical conductors | Electrical insulators |
|---|---|
| **1.** ..... | **1.** ..... |
| **2.** ..... | **2.** ..... |
| **3.** ..... | **3.** ..... |
| **4.** ..... | **4.** ..... |

# C Types and Components of Electrical Circuits

**Glossary**

**loop:** a structure the end of which is connected to the beginning
**fuse:** a safety device consisting of a strip of wire that melts and breaks an electric circuit if the current exceeds a safe level
**socket:** an electrical device made to receive a plug or light bulb to make a connection
**power cord:** a cable that temporarily connects an appliance to the mains electricity supply
**appliance:** a device or piece of equipment designed to perform a specific task
**circuit breaker:** an automatic device for stopping the flow of current in an electrical circuit as a safety measure
**switch:** a device for making and breaking the connection in an electrical circuit
**dimmer:** a device for varying the brightness of an electric light

An electrical circuit is a set of electrical components that are connected together in a **loop** with a power source, that allows current (electrons) to flow through it.

## Types of Electrical Circuit

There are different ways of categorizing electrical circuits. One way is series versus parallel circuits. A **series circuit** is a circuit where the components are connected in one continuous loop. A **parallel circuit** is a circuit where the components are connected in separate branches. Most real life circuits are combinations of these two concepts, since each type has its own advantages. When something breaks in a series circuit, the whole circuit stops working. This doesn't happen with parallel circuits. A series circuit can therefore be useful for safety features like **fuses**, but not so useful for Christmas lights. Series circuits are also cheaper to produce.

Another way of classifying circuits is to separate them by power type: direct current (DC) or alternating current (AC). **Direct current** is where the electricity flows in one direction. **Alternating current** is where the electricity flows back and forth in both directions, usually switching 60 times a second.

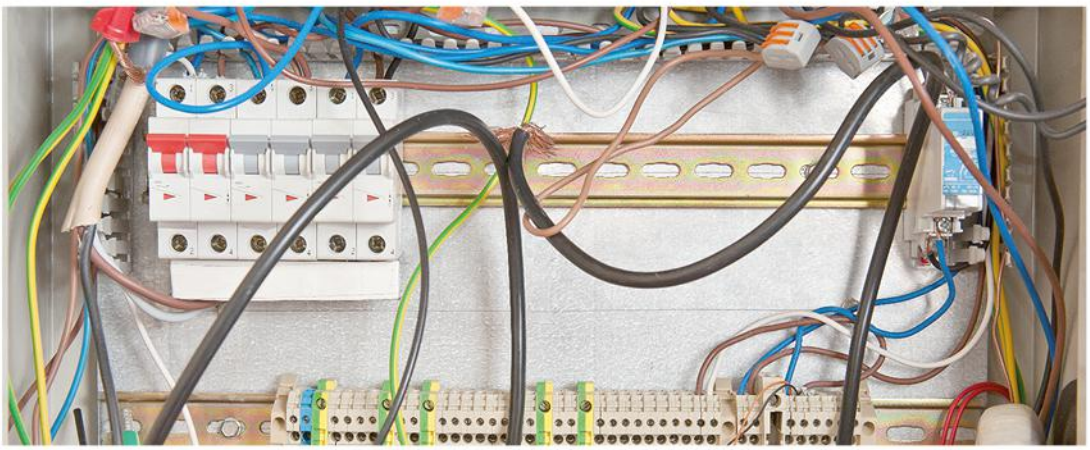
The current supplied by wall **sockets** is AC. There are a number of reasons for this: for example, generating AC electricity is easier, and you can transfer it over long distances without losing as much energy along the way. However, many devices, especially smaller ones, use DC current. Sometimes when a device has a large box as part of its **power cord**, that's because it is converting AC current into DC current. It's much easier to do this in your home on a small scale than at the power station.

## Component Parts of an Electrical Circuit

An electrical circuit has the following five components.

- A load. This is something which needs electricity to make it work. It might be an electric lamp, an electrical **appliance** or an electric motor.
- A source of electrical energy. This might be a battery giving a DC (direct current) supply or the mains supply which is an AC (alternating current).
- A source of circuit protection. This might be a fuse or **circuit breaker** which will protect the circuit from «overcurrent» or excess current.
- The circuit conductors or cables. These carry voltage and current to power the load.
- A means to control the circuit. This might be a simple on/off **switch** but it might also be a **dimmer** or a thermostat.

(Adapted from Trevor Linsey, *Electrical Installation Work*, Newnes, 2011)

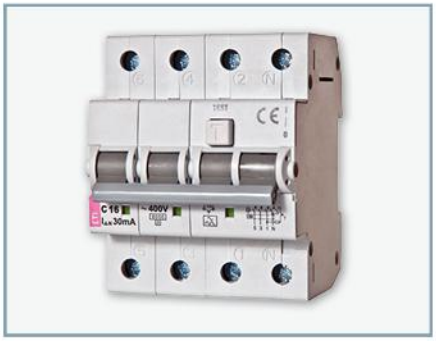


## Understanding the text

**10.** **Place the following terms and expressions under the corresponding image.**

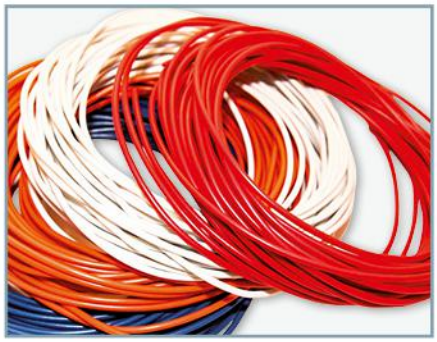
fuse • circuit breaker • socket • switch • cables • appliance

1. .....



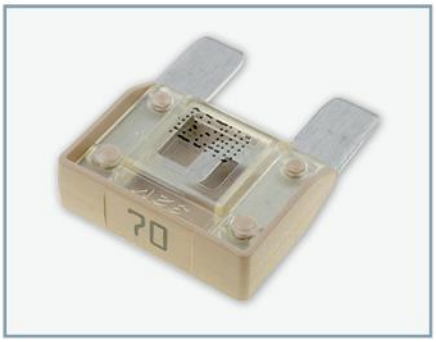
2. .....

3. .....



4. .....

5. .....



6. .....

**11.** **Find terms and adjectives in the text that are associated with the following words.**

1. ....., ....., ....., ..... circuit
2. ..... components
3. ..... source
4. ..... features
5. ....., ....., ..... current
6. ..... socket

**12.** **Complete the following sentences. Your answers must be related to the text.**

1. The basic idea of a ..... circuit is that the components are connected end-to-end to form a single path for electrons to flow.
2. In a .....circuit if a lamp breaks or a component is disconnected, the circuit is broken and all the components stop working.
3. In a ..... circuit different components are connected on different branches of the wire.
4. If the current flows only in one direction, it is called .....
5. If the current flows back and forth, it is called .....
6. Most of our homes are supplied with ..... current.
7. Electronic devices like computers, phones and calculators use ..... current.

**13.** **Place the following terms and expressions in the right row. One has been done as an example.**

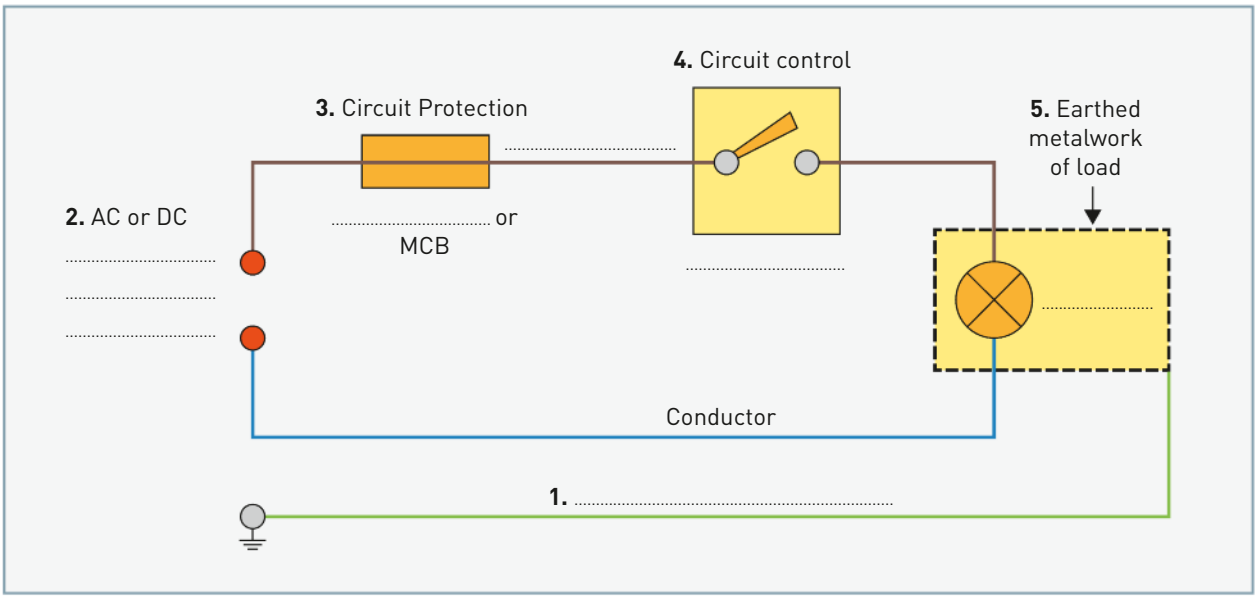
~~wires~~ • cables • switches • sockets • batteries • appliances • series circuit • light bulb • meter • fuse • circuit breaker • electric motors • parallel circuit

| | |
|---|---|
| Types of electrical circuits | ..... |
| Elements that allow the flow of electricity | *Wires* ..... |
| Devices that control and/or block the flow of electricity | ..... |
| Devices that measure the flow of electricity | ..... |
| Devices that make use of electricity | ..... |
| Devices that store electrical energy | ..... |

## Listening

1

**14.** **Listen to this lesson on the component parts of an electrical circuit and complete the diagram with the correct terms or expressions.**




1

**15.** **Listen again to the lesson and complete the following sentences.**

1. ..... showing you a diagram that illustrates an electrical circuit and its components.
2. ....., the brown line is the line conductor, the blue line the neutral conductor and the green line indicates the protective conductor.
3. ..... the AC or DC supply energy source.
4. The rectangle ..... indicates the circuit protection, fuse or MCB, that stands for miniature circuit breaker.
5. The square ..... is the circuit control, the switch.
6. ..... the dotted square on the right hand side represents the earthed metalwork of load.

## GRAMMAR CORNER

### Asking questions

When you want to ask questions, you use question words such as:

| | | | | | |
|---|---|---|---|---|---|
| **What** | → | to ask for information | **Who** | → | to ask about identity |
| **When** | → | to ask about time | **Whose** | → | to ask about ownership |
| **Where** | → | to ask about place | **Why** | → | to ask for a reason |
| **Which** | → | to ask about choice | **How** | → | to ask about manner |

**16.** **> Grammar < Complete the following sentences with the correct question word. In some cases more than one word can be used.**

1. ..... do you want to study electrical engineering?
2. ..... branch of electrical engineering you are most interested in?
3. ..... do you want to work?
4. ..... would you like to work with?
5. If you decide to set up your own business, ..... are you going to find the money needed?
6. ..... kind of products/services would you like to offer?
7. ..... are you going to advertise your products or services?

CAREERS

### ELECTRICIAN: A JOB IN HIGH DEMAND

Employment for electricians is projected to grow faster than the average growth of jobs in other occupations. As homes and businesses require more wiring, electricians will be needed to install the necessary components.

The job duties of an electrician include:

- installing, testing and maintaining wiring and electrical systems
- identifying electrical problems
- repairing or replacing wiring, equipment or fixtures
- conforming to state and local building regulations.

**17.** **Have a look at the two job ads on the following page and complete the table with the correct information.**

| | Ad 1 | Ad 2 |
|---|---|---|
| Location | ..... | ..... |
| Job requirements | ..... | ..... |
| Job type | ..... | ..... |
| Pay per hour | ..... | ..... |
| How to apply | ..... | ..... |

## Electrician

**Location:** Grimsby, Ontario
**Job Type:** Permanent
**Reference number:** 453244STFEN
**Basic Job Info:**

- Electrician
- $30 per hour plus premiums
- Full-time
- Hamilton
- Rotating Shifts

**Ad 1**

**Introduction:** A leading manufacturer in Hamilton is currently seeking an experienced electrician to join their growing maintenance team. Our client is using state-of-the-art equipment and is seeking a forward-thinking individual with experience in fast-paced environments and automated machinery.

**Benefits:**

- Salary: based on experience $52,000 - $65,000
- Benefits: after 3 months, Dental, Vision & Medical
- Retirement planning
- Great work environment with fostering company culture for long term careers
- Opportunity for career growth and promotion

**Who are we looking for?**

- Minimum 2 plus years of experience in fast-paced automated environments including but not limited to heavy equipment
- Proven ability to multitask and troubleshoot quickly to minimize down time

**How to apply:**
E-mail your resume to Hamilton Skilled: trades@randstad.ca

## Electrician

**Location:** Central London

- Electrician required for a project based in Islington, London

**Ad 2**

- **Requirements:**
- Minimum of 5 years experience working as a qualified electrician
- Must have good communication skills
- Must be hardworking, reliable with a good work ethic
- Immediate start
- £17.50 per hour
- 10 hours per day
- Possible weekend work available (overtime rate)
- 6 month contract
- Please call Amoret at JBS on 020 8872 4380
- Ad ID: 1170131724

**18.** **Answer the following questions.**

1. What are the main advantages/disadvantages of the job in the first ad?

.....

2. And of the second one?

.....

3. Which of these two jobs would you be interested in? Why?

.....

Unit 2

# How to Carry out an Electrical Design Project

## Knowledge
- Electrical installations
- Steps in the electrical design process

## Skills
- Determining the scope of an electrical design project
- Understanding how to create an electrical plan
- Presenting a project for a lighting system
- Discussing lighting systems at school
- Researching tools and equipment for electrical jobs
- Solving some common electrical problems

## Competences
- Making an electrical design plan


## Warm up

**1.** **An electrical installation has to go through a precise series of stages. Can you put the following sentences in the right place?**

**a.** Compile all project parts and complete a set of plans.
**b.** Define and design each component.
**c.** Evaluate the client's requirements and the existing electrical system.

| Stage 1 | Stage 2 | Stage 3 |
|---|---|---|
| ..... | ..... | ..... |

**2.** **Place each of the terms and expressions below next to its English correspondent.**

presa di corrente • dati tecnici • piano, progetto • sistema di illuminazione • sistema di circuiti • quadro di controllo • impianto elettrico • cavo, filo elettrico

| | | | |
|---|---|---|---|
| 1. wiring system | | 5. circuitry | |
| 2. wire/cord | | 6. switchboard | |
| 3. lighting system | | 7. blueprint | |
| 4. receptacle/socket | | 8. specifications | |

# A Electrical Installations

**Glossary**
**(to) implement:** to put into effect
**twice:** two times
**set:** established
**Hz:** is the symbol of the hertz, the basic unit of frequency

Electrical installations are systems that make use of electricity. Each installation consists of the power supply system, wiring system, protection systems and the loads to be powered. For an electrical system to work it must be properly designed and **implemented**. The correct type of power supply should be used at all times. This means that the AC power supply system should be used for AC loads while the DC power supply system should be used for DC loads. An appropriate wiring system should also be used. The wires should be properly protected.

## Electrical Supply Systems

Different countries in the world use different forms of electrical supply systems. Europe and most other countries in the world use a voltage which is about **twice** that of the US. In these countries, the electricity supplied to houses, shops, offices and small industrial consumers is nominally **set** at between 220 and 240 volts. On the contrary, in Japan, in the US and most of the Americas, the voltage is nominally set between 100 and 127 volts. Another major difference for most countries is the frequency. Most countries also use a frequency that is either 50 **Hz** or 60 Hz.

(Adapted from Uma Rao and A. Jayalakshmi, *Basic Electrical Engineering*, Pearson Education, 2010)

## Understanding the text

**3.** **Tick the topics mentioned in the text.**

1. ☐ Component parts of an electrical installation
2. ☐ Power supply types
3. ☐ Lighting systems
4. ☐ Types of lamps
5. ☐ Wire protection
6. ☐ Electrical protective devices
7. ☐ Electrical supply systems
8. ☐ Electrical blueprint reading

**4.** **Match each of the following verbs with its synonym.**

1. ☐ make use of
2. ☐ consist of
3. ☐ work
4. ☐ implement
5. ☐ supply

**a.** put into effect
**b.** be made up of
**c.** provide
**d.** function
**e.** employ

INTERESTING FACTS

### WHY ISN'T THERE A STANDARD VOLTAGE AROUND THE WORLD?

Originally Europe used 120 V too, just like Japan and the US today. It seemed necessary to increase voltage to get more power with less losses and voltage drop from the same copper wire diameter. At the time the US also wanted to change, but because of the cost involved to replace all electric appliances, they decided not to. In the 1950s-1960s the average US household already had a fridge, a washing machine, a dryer, etc., but not so in Europe.

The end result is that now it may seem to some people that the US has not evolved from the 1950s and 1960s, and still copes with problems such as light bulbs that burn out rather quickly when they are close to the transformer (too high a voltage), or just the other way round: not enough voltage at the end of the line.

# B Electrical Design Plan

**Glossary**

**(to) remodel:** to renew, renovate
**(to) convey:** to communicate
**trade:** business
**scope:** aim or purpose

For all building construction or **remodelling** building projects, the owner or occupant must first have a concept for the new design, and then the architect or designer can produce a set of building plans. These plans **convey** all the required information to the local inspection authority and associated building **trades** so that the construction or remodelling can take place. Because commercial and industrial buildings contain a number of electrical systems, these plans include specific electrical design and additional documentation to verify that the design conforms to all required building codes.

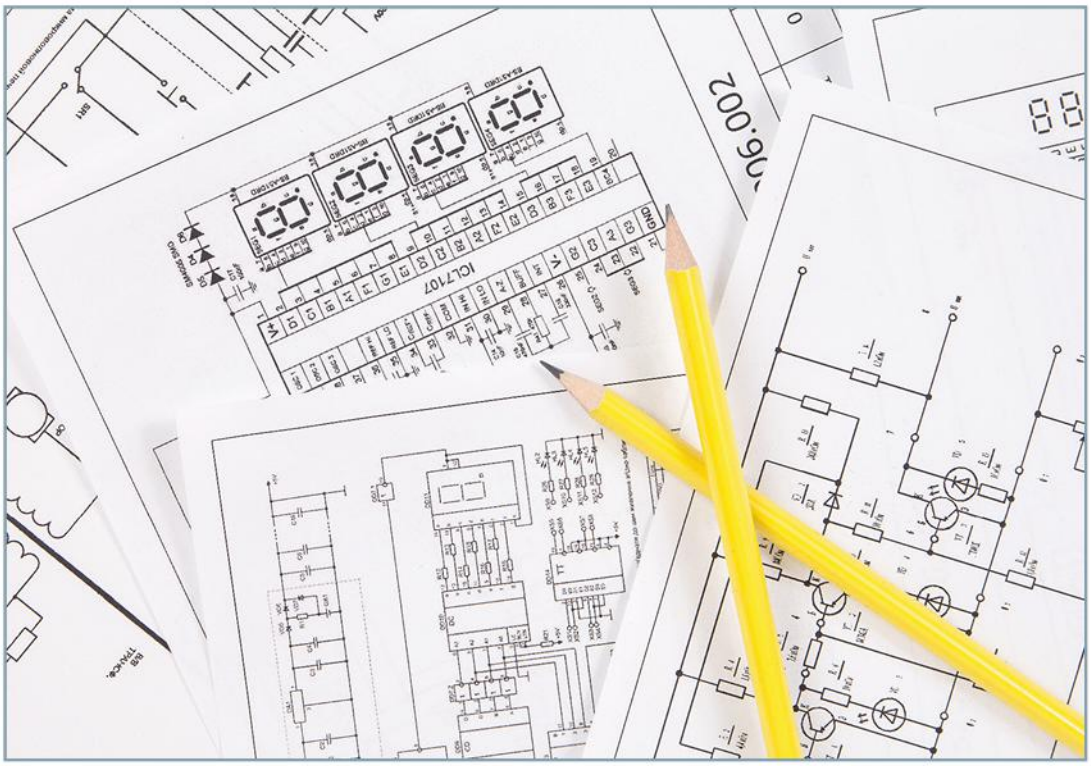
## The Design Process

An electrical design goes through several important stages of development. First, the designer must understand the **scope** of the project. Then, the designer defines and designs each component (such as general office areas, specialized machinery and power distribution equipment) to recognized industry standards. Finally, these individual components are compiled to form the final presentation of the design.

## Understanding the Project Scope

Every electrical design has unique requirements, depending on the scope of the project. The project scope is determined by the customer's requirements and the type of structure that the customer will occupy. For example, if the project requires new electrical systems for an existing building then the electrical designer works to incorporate all the new electrical wiring into the existing system. The designer must evaluate the existing electrical systems to ensure that they can accommodate any new additional electrical loads that will be imposed on them. When the design is for a proposed new facility, then the scope of the project is much greater. Electrical designs for these types of projects require an entirely new electrical system design.

(Adapted from John Hauck, *Electrical Design of Commercial and Industrial Buildings*, Jones & Bartlett, 2009)



## Understanding the text

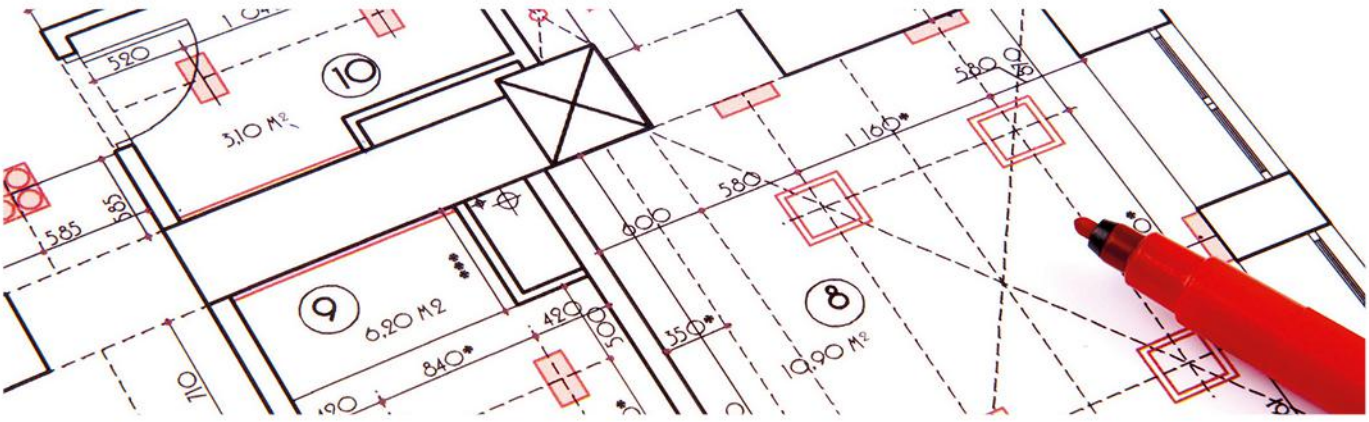
**5.** **Find verbs in the text that are associated with the following terms or expressions.**

| | | |
|---|---|---|
| **1.** | ..... | a concept |
| **2.** | ..... | plans |
| **3.** | ..... | information |
| **4.** | ....., ....., ..... | electrical systems |
| **5.** | ..... | stages of development |
| **6.** | ..... | the scope |
| **7.** | ....., ..... | components |
| **8.** | ..... | a presentation |

**6.** **Read the text and provide the information required.**

| People involved in the production of building plans | Information contained in building plans |
|---|---|
| **a.** ..... | **a.** ..... |
| **b.** ..... | **b.** ..... |

| Stages of the design process | Elements to evaluate for an electrical design |
|---|---|
| **a.** ..... | **a.** ..... |
| **b.** ..... | **b.** ..... |
| **c.** ..... | **c.** ..... |



# C Defining Parts of the Electrical System

**Glossary**

**receptacle outlet:** an electrical socket
**grounding:** the process of removing the excess charge of an electrical supply
**detailed:** precise
**facility:** a place
**switchboard:** an apparatus for varying connections between electrical circuits in other applications

Depending on the overall scope of the project, a design can include the following components:

- general electrical requirements (e.g. general purpose receptacles)
- specialized electrical requirements (e.g. specialized office equipment and machinery)
- lighting systems
- electrical distribution systems.

## General Electrical Requirements

General electrical requirements should be defined first on any electrical design project. They include items such as the 240 volt general purpose **receptacle outlets** located throughout the commercial or industrial building. These receptacles are usually not specified to serve any particular load, but rather are for general purpose use such as for desktop devices, standard wall receptacles, and desktop equipment with no special electrical requirements.

## Specialized Electrical Requirements

Certain projects may include specialized electrical equipment that requires separate or dedicated electrical circuitry that only serves the specialized equipment. This equipment may be of the following types:

- computers and/or network servers
- photocopiers
- microwave ovens or other lunchroom appliances
- vending machines.

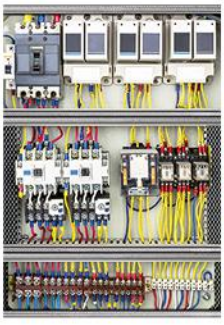
Because of their electrical load requirements, as per manufacturer's requirements, these pieces of equipment may require individual circuitry and special **grounding** methods.

## Lighting Systems

Because of their complexity, lighting systems are the part of the design process that generally requires the greatest amount of time to develop. These systems include all the lighting fixtures and their controls. Lighting systems have very **detailed** requirements and need documentation showing that the system incorporates all required energy-saving technologies.

## Electrical Distribution Systems

An electrical distribution system is the installed equipment that provides the distribution of electrical wiring throughout the **facility**. It includes the main **switchboard**, which receives the power source from the serving utility and all the associated components such as panel boards that distribute all the required branch circuits throughout the facility. Part of the process of designing the distribution system is calculating the facility's amperage load and short-circuit values; these values determine the total electrical demand requirements of the facility based on the individual parts of the electrical distribution system.



(Adapted from John Hauck, *Electrical Design of Commercial and Industrial Buildings*, Jones & Bartlett, 2009)

## Understanding the text

**7. Find adjectives or terms that are associated with the following words. When you have finished, translate the word associations that you do not understand.**

| | | |
|---|---|---|
| 1. | ....., ....., ....., ....., ....., ..... | requirements |
| 2. | ..... | project |
| 3. | ....., ..... | building |
| 4. | ..... | purpose |
| 5. | ....., ..... | circuitry |
| 6. | ....., ....., ....., ..... | equipment |
| 7. | ..... | system |
| 8. | ..... | technologies |

**8. Choose the correct synonym for each of the verbs in bold from those given.**

1. General electrical requirements **include** (*comprise* • *encircle* • *achieve*) items such as the 240 volt general purpose receptacle outlets located throughout the commercial or industrial building.
2. Certain projects may include specialized electrical equipment that **requires** (*has* • *needs* • *encompasses*) separate or dedicated electrical circuitry that serves only the specialized equipment.
3. Lighting systems are the part of the design process that generally requires the greatest amount of time to **develop** (*prosper* • *upgrade* • *create*).
4. An electrical distribution system is the installed equipment that **provides for** (*supplies* • *maintains* • *contributes*) the distribution of electrical wiring throughout the facility.
5. Part of the process of designing the distribution system is **calculating** (*reducing* • *considering* • *adjusting*) the facility's amperage load and short-circuit values.

**9. Answer the following questions. Use some of the word associations and verbs from the previous exercises.**

1. What is the first element to be defined in an electrical design project?
2. What may equipment such as lunchroom appliances or vending machines need?
3. Why are lighting systems very complex to develop?
4. What is the main function of an electrical distribution system and what are its main components?

**10. Draw a sketch of your bedroom indicating where the following elements are located.**

- Receptacle outlets
- Specialised equipment (computer, printer etc.)
- Lighting fixtures

# D Creating the Electrical Plan

**Glossary**

**blueprint:** a design plan or other technical drawing
**specification:** a detailed description of the design and materials used to make something
**(to) arise:** to emerge, become apparent
**(to) label:** to classify
**sheet:** documentation

Read more about: **Electrical Testing**

Once the various parts and applicable standards have been determined, the designer begins compiling those parts to form the electrical design and completes a set of plans.

Historically, these plans took the form of hand-drawn **blueprints**, but today most plans are created digitally using Computer-Aided Design (CAD) software tools. Digitized plans are easier to revise and transmit than those drawn with pen and pencil.

On the plan, each device should be referenced by using the appropriate electrical symbol. Electrical symbols allow for universal recognition of each part by the many people who will be working on the project so that they can estimate costs appropriately and construct the project to the **specifications**. Not all symbols are used on every project, so the specific symbols used on a particular project should be included in a symbols list and attached to the final design. Occasionally the need may **arise** for a new symbol, such as a symbol for a newer energy-saving or energy management device. In this case, the designer may create a new symbol for the electrical design plan, as long as it is added to the symbols list included with the plan.

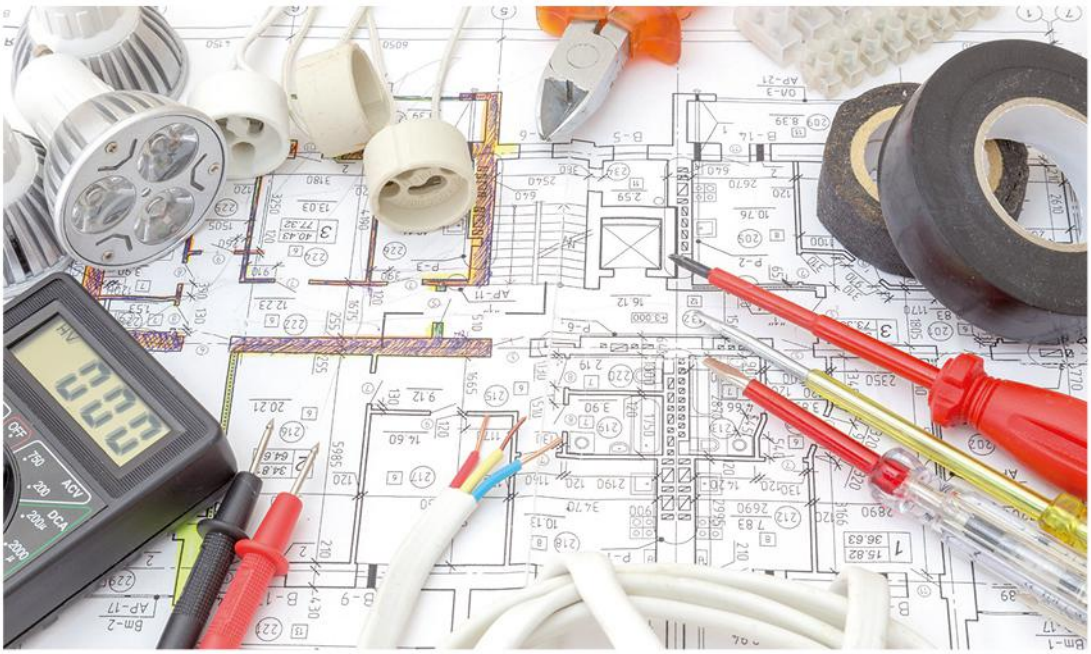
Electrical design plans may be included as a separate document within a complete set of building plans. To identify the electrical plans, each page of the electrical design is **labeled** and numbered.

Electrical **sheets** are generally presented in the following order:

- exterior electrical site plan
- interior electrical power plan
- interior lighting plan
- documentation (such as panel schedules, electrical circulations, single line diagrams and lighting systems energy requirements).

It is important to note that the number of electrical sheets required for a project varies based on the amount of required information by each project. Also to be taken into account is how much of that information can fit on one page and still provide a clear, concise, set of prints easy to understand.

(Adapted from John Hauck, *Electrical Design of Commercial and Industrial Buildings*, Jones & Bartlett, 2009)



## Understanding the text

**11. Place each of the verbs below next to its synonyms.**

compile • revise • estimate • attach • create • provide

1. review, look over .....
2. calculate, evaluate .....
3. make, develop .....
4. enclose, annex .....
5. gather, assemble .....
6. supply, furnish .....

**12. Complete the following sentences. Your answers must be related to the text.**

1. The electrical design and a set of plans can be completed when ..... .
2. In the past drawings were made ..... .
3. Today designers use ..... and this offers a number of advantages including that ..... .
4. Electrical symbols are used to ..... . They permit ..... .
5. Electrical sheets usually include ..... .
6. When preparing electrical sheets it is important to remember to organize information so that ..... .

**13. Find terms and expressions in the text which mean much the same as the following ones.**

1. Una volta che .....
2. In passato .....
3. Qualche volta .....
4. In questo caso .....
5. È importante notare che .....
6. Va anche tenuto in considerazione .....

## Writing

**14. Write a short summary (about 120-150 words) of the texts (A, B, C, D) in this unit. Use some of the terms and expressions from the previous exercises. Focus on the following elements.**

- Definition of an electrical installation
- Elements involved in it
- Steps in the electrical design process
- Presentation of electrical design plans

## Listening

**15.** 2 **Dextra Lighting, a company based in the UK, provides lighting systems. Listen to Jack Glare, one of the company's designers, who is presenting the project for the lighting system for a school to its board of trustees and choose the right answer.**

**1.** The classroom space has a
- **a.** ☐ 3 metre high ceiling.
- **b.** ☐ 2.5 metre high ceiling.
- **c.** ☐ 4 metre high ceiling.

**2.** They have chosen
- **a.** ☐ suspended glass luminaires.
- **b.** ☐ recessed lensed luminaires.
- **c.** ☐ pendent luminaires.

**3.** The purpose is to evenly illuminate
- **a.** ☐ only the vertical surfaces.
- **b.** ☐ both vertical surfaces and the classroom desktops.
- **c.** ☐ only the desktops.

**4.** The luminaires measure
- **a.** ☐ 30 × 100 cm.
- **b.** ☐ 40 × 110 cm.
- **c.** ☐ 50 × 100 cm.

**5.** This solution
- **a.** ☐ eliminates glare on all computer screens.
- **b.** ☐ does not eliminate glare on older computer screens, but works well on flat screen monitors.
- **c.** ☐ eliminates glare only if other lighting is added.

**6.** The average illumination is
- **a.** ☐ 63 foot candles.
- **b.** ☐ 33 foot candles.
- **c.** ☐ 43 foot candles.

**16.** 2 **Listen to the presentation again and complete the following sentences.**

**1.** ..... for the lighting system for your school.

**2.** ....., classroom lighting rarely meets the functional needs of teachers and students.

**3.** ..... to install high-performance lensed luminaires.

**4.** ..... a space that is almost perfectly uniform and where accent lighting could be added to create visual interest.

**5.** ..... the installation specifications and the map that you have in your folder, there are 9 luminaires.

**6.** ..... energy saving strategies on page 3.

## Open discussion

**17.** **> Pair work <** **The modern classroom requires a range of lighting scenarios, from the full lighting needed for traditional teaching to the various levels of dimming and light distribution for audiovisuals, whiteboards and other activities. Most existing systems do not have the flexibility to provide high-quality lighting in this varying environment. Answer the following questions.**

1. Do you agree with this statement? Why?
2. Is the lighting system in your classroom effective? Why?
3. If you could install a new lighting system what would it be like?

**When you have finished, compare your answers with those of your classmates.**

## GRAMMAR CORNER

### Talking about location

When you want to indicate where something is located, you use a preposition of place.

| Preposition | Meaning | Examples |
|---|---|---|
| **in** | indicates that something is enclosed or surrounded by something | *The nails are **in** the box.* |
| **into** | indicates towards the inside or middle of something and is used with verbs of movement | *Can you put that measuring tape **into** the toolbox?* |
| **on** | indicates position on a horizontal or vertical surface | *The drill is **on** the shelf.* |
| **under** | indicates in or to a position below or lower than something else | *The radiator will be placed **under** the window.* |
| **over/above** | indicates above or higher than something else | *There is a sign **over** the door.* |
| **next to** | indicates two people or things that are very close to each other | *The stairs are **next to** the living room.* |
| **in front of** | indicates close to the front part of something | *The fuse box is **in front of** the kitchen.* |
| **opposite** | indicates situated on the other side | *The hardware store is **opposite** this building.* |
| **behind** | indicates at the back of something | *The circuit breaker panel is **behind** the wall.* |
| **at** | indicates an exact position or particular place | *I'll meet you **at** the entrance.* |
| **through** | indicates movement from one side of an enclosed space to the other | *The cable runs **through** the wall.* |
| **between** | indicates in the middle of two things | *The socket is **between** the door and the window.* |

**18. > Grammar < Look at the image below and write at least five sentences using some of the prepositions of place mentioned.**

TOOLS AND EQUIPMENT

## THE TOOLS OF THE TRADE

For all electrical jobs you must be equipped with the appropriate tools. The basic ones include:

- screwdrivers: standard, cabinet and Phillips tip
- pliers
- a keyhole saw
- a hacksaw
- scissors and shears
- a utility knife
- a steel measuring tape
- an electric drill
- a cable stripper for slicing through the sheathing on non-metallic cable
- a wire stripper for removing the insulation from the wires
- a multipurpose tool for measuring, stripping, and wire cutting
- wire connectors
- waterproof electrical tape
- fish tape for running cable behind walls or through conduits

An electrician's basic testing tools include:

- a voltage tester: it is used with the current turned on to determine whether there is current flowing through a wire and to test for proper grounding
- a volt-ohmmeter, or multitester: it tests for continuity, power, and grounding and measures voltage and resistance
- a continuity tester: it is a battery powered device used to detect shorts and other flaws in sockets, switches, appliances and extension cords and to see if a fuse is good

**19.** **Place the following words under the correct image.**

screwdriver • steel measuring tape • pliers • electric drill • wire connectors • cable stripper • fish tape • shears

1. .....

2. .....

3. .....

4. .....

5. .....

6. .....

7. .....

8. .....

**20.** **> Pair work <** **Which tool do you need? Write the correct tool next to each sentence.**

1. You have to tighten a screw: .....
2. You want to measure the length of a wall: .....
3. You need to make a hole in the wall: .....
4. You have to remove insulation from wires: .....
5. You have to pull wires through pipes: .....
6. You have to test for continuity and measure voltage: .....

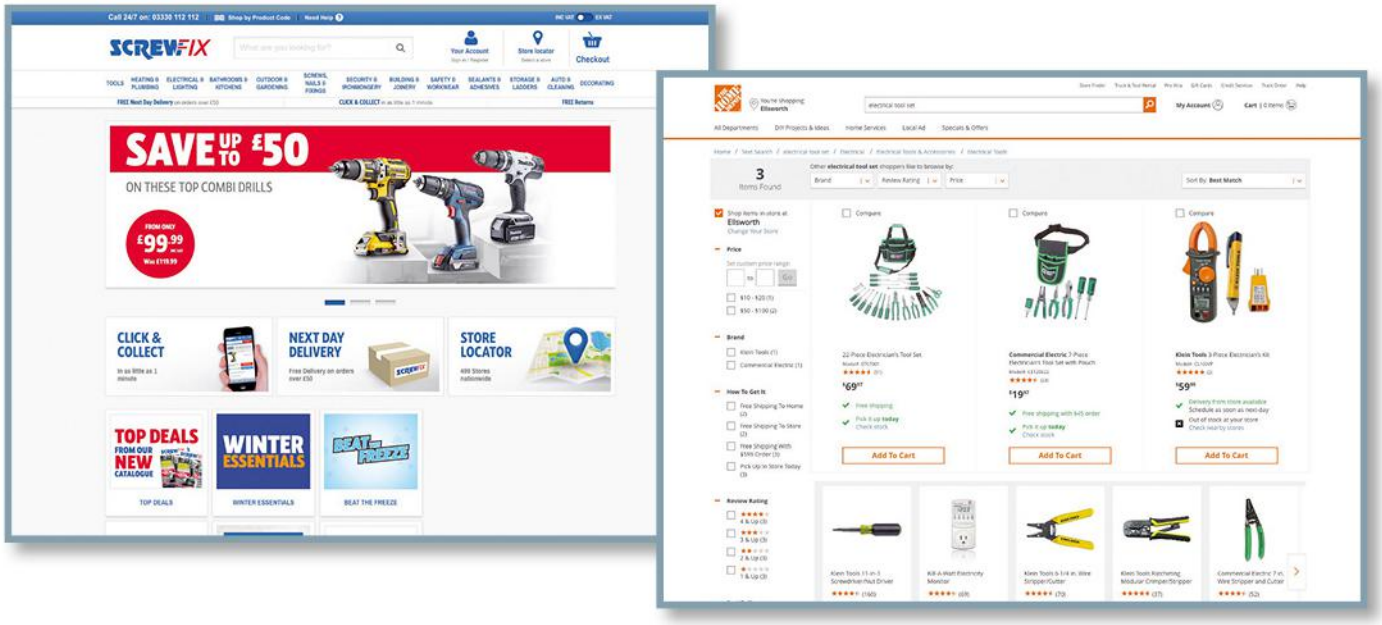
## Investigate!

**21.** **An English friend of yours would like to carry out some minor electrical jobs in his house and has asked you for some advice on the tools and equipment necessary. Write down a list of the tools and equipment along with the price of each item.**

**You can look at the following websites:**
www.screwfix.com
www.homedepot.com
www.amazon.co.uk

| Tool or equipment | Price |
|---|---|
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| | Total ..... |

**When you have finished, compare your prices with those of your classmates.**



## Problem solving

**22.** **> Pair work <** **Look at the table below listing some common electrical problems and their possible causes. In pairs, think of some possible remedies. When you have finished, compare your answers with those of your classmates. One has been done as an example.**

| Problem | Possible cause | Remedies |
|---|---|---|
| Some lights on a circuit do not work. | **1.** Loose wiring<br>**2.** Faulty switch | **1.** *Tighten connections at switch or fixture*<br>**2.** ..... |
| All lights on a circuit do not work. | **1.** Overloaded circuit<br>**2.** Short circuit<br>**3.** Loose wiring<br>**4.** Faulty switch | **1.** .....<br>**2.** .....<br>**3.** .....<br>**4.** ..... |
| Appliance or lamp does not work. | **1.** Overloaded circuit<br>**2.** Damaged plug<br>**3.** Damaged cord<br>**4.** Loose wiring<br>**5.** Defect in appliance or lamp | **1.** .....<br>**2.** .....<br>**3.** .....<br>**4.** .....<br>**5.** ..... |

# Let's put theory into practice

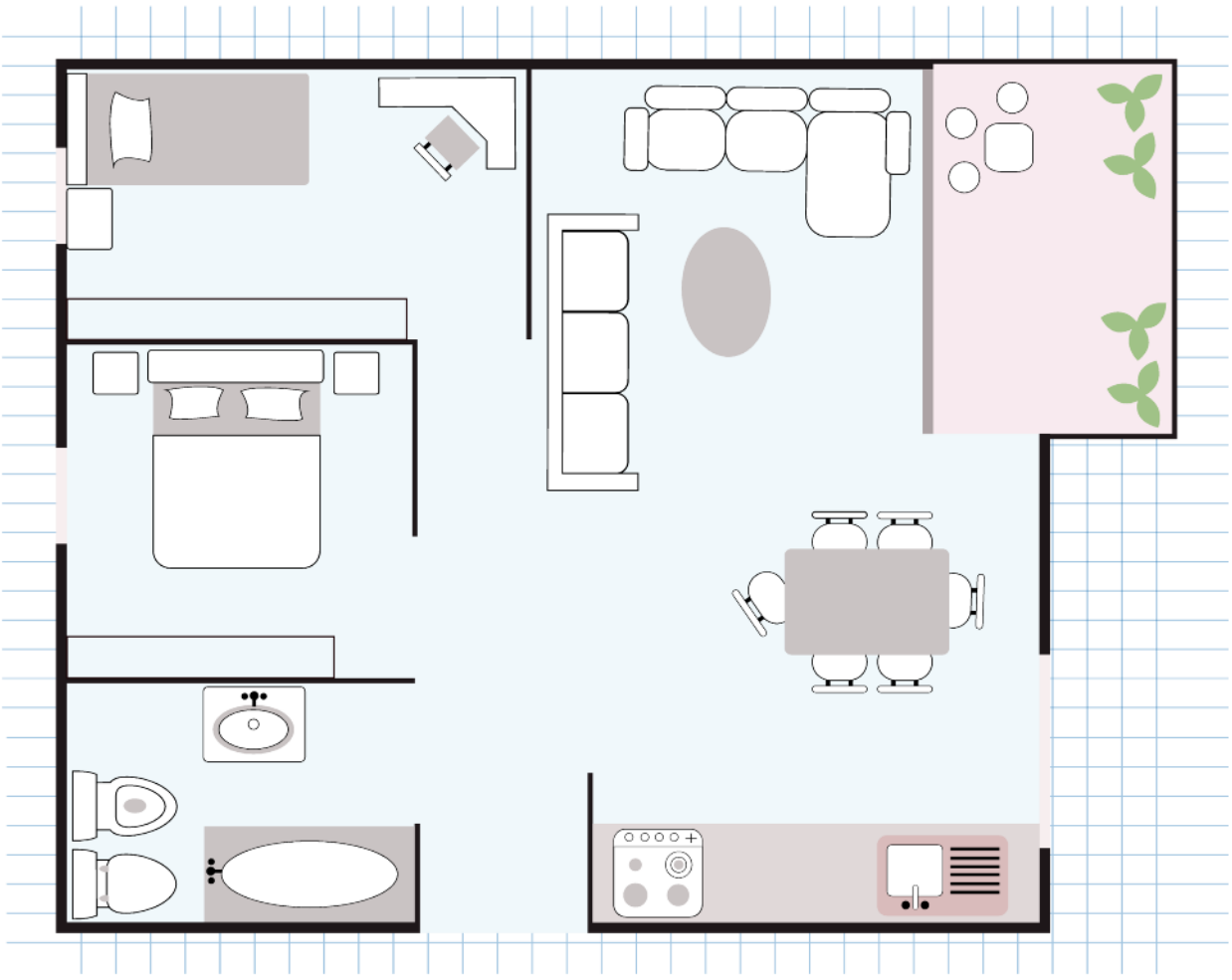
## MAKING AN ELECTRICAL DESIGN PLAN

1. **Group work. Form three or more groups. You work for your own electrical company. First think of a name, address and phone number for your company.**

2. **You have been asked to make an electrical design plan for the flat shown below.**

   a. Make a list of the materials you will need.
   b. Draw on the plan where you would place the various elements of the electrical system.
   c. Calculate the amount of material needed, installation time etc. and fill in the quote on the next page.
   d. Present your design plan to your classmates. Use some of the terms and expressions that you have found in this module.

3. **In turn, one group will represent the client and will decide whether your project is excellent/ good/not satisfactory.**
   **Give reasons for your evaluation and when necessary suggest how to improve the plan designs.**



## Let's put theory into practice

Company name: .....

Date: .....

Address: .....

Phone number: .....

**Customer:** Kevin Dude
**Address:** 72 York St, London W1D 1NU
**Phone:** +44 20 7623531

**Description of work**

.....

.....

.....

**Hourly labour charges**

| Quantity | Description | Price |
|---|---|---|
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| | Sub Total | ..... |

**Parts & Materials**

| Quantity | Description | Price |
|---|---|---|
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| | Sub Total | ..... |

**Other charges**

| Quantity | Description | Price |
|---|---|---|
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| | Sub Total | ..... |

**Total charges:** .....