

Becker Müller

Lösungen

Electricity now!

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Autoren:

Nicola Becker, Studiendirektorin, Bonn

Detlev Müller, Oberstudienrat, Hennef

Verlagslektorat:

Andreas Nies

Vorwort

Das Lösungsbuch zum Lehrwerk Electricity now! enthält die Lösungen zu den Activities – den Aufgaben – der einzelnen Kapitel. Bei eindeutigen Lösungen sind diese aufgeführt, bei freien oder individuellen Antwortmöglichkeiten werden Beispiellösungen zur Verfügung gestellt.

Dies erlaubt einen schnellen Überblick über die genauen Anforderungen und Erwartungen der einzelnen Übungen. Gleichzeitig gibt der Löser Hilfestellung bei fachlichen oder sprachlichen Unsicherheiten im Fall eines fachfremden Einsatzes der Lehrkraft.

Über die reinen Lösungsvorschläge hinaus beinhaltet das Lösungsheft:

- Transkripte der Hörtexte für einen schnellen Überblick über die gesprochenen Texte und Dialoge.
- eine Zuordnung der einzelnen Kapitel zu den Lernfeldern unterschiedlicher Ausbildungsberufe der Elektrotechnik. So kann das Werk Electricity now! auch zur Vertiefung der technischen Unterrichtsinhalte oder für bilinguale Module verwendet werden.
- Abbildungen und Tabellen, die in Electricity now! abgedruckt sind. Diese erlauben eine Projektion für einen digital unterstützten Unterricht.

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Zuordnung der Inhalte zu Ausbildungsjahren und Lernfeldern

		Elektroniker für Energie- und Gebäudetechnik			Elektroniker für Betriebstechnik			Mechatroniker		
	Ausbildungsjahr	1.	2.	3.	1.	2.	3.	1.	2.	3.
		Zugehöriges Lernfeld								
1	Company	1,2			1,2					
2	Basic Circuit	1			1			3		
3	Resistance	1			1			3		
4	Measuring Basics	1			1			3		
5	Electrical Safety	1	5		1	5		5		
6	Installation Basics	2			2			3		
7	Installation Material	2			2			3		
8	Tools	2			2			3		
9	Lamp Circuits	2			2			3		
10	Batteries	1			1			3		
11	Fuses and Circuit Breakers	2	5		2	5		3		
12	Protection against Electric Shock	1,2	5		1,2	5		3		
13	Information Technology	4			4			5		
14	Control Engineering	3	7		3	7			7	
15	Appliances			10						
16	Electric Motors		8			8			7,8	
17	Motor Protection		8			8			7,8	11
18	Customer Service	2		10	2					
19	Professional Measuring		5			5		3	8	11
20	Energy			10			10			
21	Power Supply Units		6			6		3	7	
22	Light and Lamps			10			9			
23	Solar Energy			11			9			
24	Power Electronics		6,8	11		6,8	11		8	
25	Power Failures			11			9			
26	Smart Home			10			11			
27	Lightning Protection			10			9			
28	Industry 4.0						11		9	11
29	Security Systems			9			9			
30	Electric Cars			11						
31	Heat Pumps			10			9			
32	Workshop	x	x		x	x		x	x	

1 My Company

Activity 1 Text comprehension

- a 15 Gesellen (Facharbeiter), 3 Meister, 5 Auszubildende, 3 ungelernete Arbeiter
- b Arbeitsorganisation (Arbeitspläne), Verwaltungsarbeit
- c Jack Miller leitet die Firma seit nunmehr 5 Jahren. Vorher arbeitete er bei einem lokalen Großunternehmen. Als Jacks Vater John Miller sich entschied, in den Ruhestand zu treten, übernahm Jack die Firma.
- d Neuinstallationen, Installationen in Altbauten, Reparatur von Schaltungen und Hausgeräten, Installation und Wartung von Gefahrenmeldeanlagen, Smart Home Anwendungen, Lösungen im Bereich Erneuerbare Energien
- e Unser Anspruch ist es, den Kunden zufriedenzustellen und hervorragende Qualitätsarbeit von Anfang bis zum Ende eines Projektes zu gewährleisten. Um die Bedürfnisse und Erwartungen unserer Kunden zu verstehen, legen wir großen Wert auf professionelle Arbeit und Kommunikation mit unseren Kunden. Unser guter Ruf basiert auf Service, Sicherheit und Qualität, egal ob es sich um kleine oder große Aufträge handelt.

Activity 2 Listening

- a apprenticeship
- b profession
- c to train
- d to sign a contract
- e employee
- f salary
- g vocational college
- h chamber of trade
- i trade test



(vel.plus/EL01)

Listening Chapter 1– Activity 2

Hi there, my name is Jimmy and I am an electrician apprentice. Today, I want to tell you about my apprenticeship. I come from Leeds in the UK but I live in Germany where, if you want to learn a profession, you first of all have to find a company to train you. After you sign a contract with them, your company employs you for around 3 years. As an electrician you are normally trained for three and a half years. The good thing is, you even receive a small salary during your apprenticeship.

During this time, you work with skilled colleagues who show you everything you need to learn for your job. On one or two days a week you attend a vocational college rather than going into your company. There you learn all the theoretical things you need to know. There are also some extra courses that you have to attend. They are organised by the chamber of trade. After one and a half years you have to pass your first official exam: part 1 of your trade test, which is also organised by the chamber of trade.

The second part takes place at the end of your apprenticeship. After having passed that, you are a skilled worker. And if you don't pass? Well, then you have to repeat the test six months later.

Activity 3 Dialogue writing

(Lösung beispielhaft, andere Lösungen sind möglich)

- A: Hello (Hi), good morning!
- B: Good morning. You must be Peter from Ireland, pleased to meet you.
- A: Yes, I am Peter. I am going to work with you from now on.
- B: Welcome, I am an apprentice here and I want to introduce you to our company.

We have a total of 28 employees: 15 skilled electricians, 3 master craftsmen, 5 apprentices and 3 unskilled workers. And finally, there are two secretaries working in our offices.

- A: What kind of work do you do mainly do?
- B: Our main tasks are wiring new buildings and rewiring older buildings. In addition to that we repair household appliances and install alarm systems. Finally, we also do smart home applications and renewable energy solutions e.g. installation of PV systems.
- A: Sounds interesting. In Ireland you learn at a vocational school for 1 year. Then you start working for a company. While you are at school you don't work at a company.
- B: In Germany you start working directly for a company and at the same time you attend school for one or two days a week.
- A: Does that mean you earn money during the apprenticeship?
- B: Yes, I earn 550 Euros in the first, 600 Euros in the second and 700 Euros in the final year.

A: That's cool. Is this your boss?

B: Yes, that's Jack Miller. Come on, I will introduce you.

Activity 4 Online Support

(Lösung beispielhaft, andere Lösungen sind möglich)

Dear Ms Smith,

Probably a fuse has blown, or a circuit breaker has tripped. Switch off the washing machine and the dishwasher. Then go to your fuse box and check the circuit breakers and the fuses. You might have to replace a fuse or switch on a circuit breaker. It could be the ground fault circuit breaker (RCD) as well. If you are not sure what to do at the fuse box, give us a call.

Kind regards

...

Dear Mrs Fisher,

You should check if there is power at your wall socket. Pull the PC plug out and plug in another device, e.g. a

lamp. If the lamp works, your PC is defective and has to be repaired. If the lamp does not work, check the fuse of the wall socket. If you are not sure how to do this, give us a call.

Kind regards

...

Dear Mr Baxter,

There may be a loose connection. First pull the plug of your electric drill out and plug it into another wall socket. If this does not help, there is likely a loose connection inside the drill. Otherwise it could be that the wall socket is defective and should be checked.

Kind regards

...

Activity 5 Presentation

Lösungen sind themenabhängig.

2 The Basic Electric Circuit

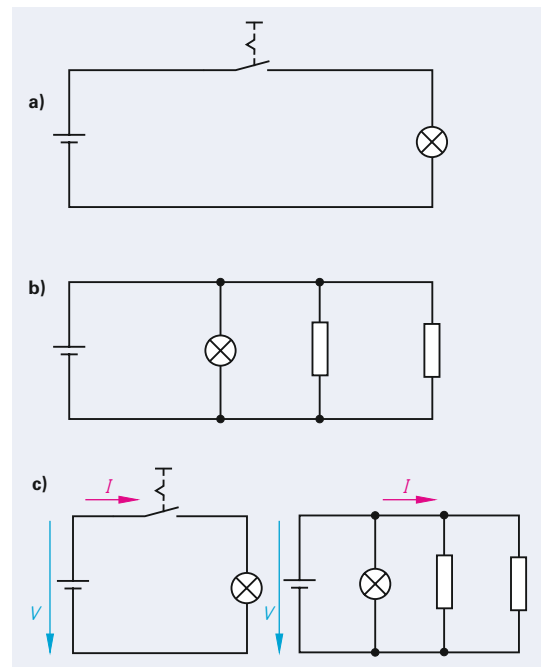
Activity 1 Text comprehension

- a** (Spannungs-)Quelle, Leiter und Last (Verbraucher) und ggf. eine Steuerung.
- b** Dazu muss ein geschlossener Stromkreis vorhanden sein, an dem eine Spannung anliegt.
- c** Metalle, wie z.B. Kupfer, weil sie Elektronen gut leiten.
- d** Als Strom bezeichnet man Elektronen, die sich in einem Stromkreis bewegen.

Activity 2 Vocabulary

- current: Strom, Strömung (Luft/Wasser), Adjektiv: geläufig
- conductor: Leiter, Dirigent, Busfahrer
- resistance: elektrischer Widerstand, Widerstand (gegen etwas)
- load: elektrische Last (Verbraucher), Last, Ladung (z.B. von Fahrzeug)

Activity 3 Draw a sketch



Activity 4 The direction of current

- a** Yes, it's true.
- b** Electrons are negative particles of atoms.
- c** Yes, they are.
- d** When the electric current was discovered, scientists thought that the current flowed from plus to minus. Only later was it discovered that electrons actually travel in the other direction.

Activity 5 Ohm's law

Georg Simon Ohm wurde 1789 in Erlangen geboren und er starb 1854 in München.

Er war ein deutscher Physiker, der herausgefunden hat, dass in jedem elektrischen Stromkreis Spannung, Stromstärke und Widerstand voneinander abhängen.

Das bedeutet, dass, wenn man zwei der drei Werte kennt, man den dritten berechnen kann.

Die Regel, die diese Beziehung mathematisch beschreibt, nennt man das Ohm'sche Gesetz.

Weil dies eine wichtige Entdeckung war, wurde die Einheit des Widerstandes (Ohm) nach Georg Simon Ohm benannt.

Das Ohm'sche Gesetz gilt für alle Widerstände, die sich mit der Stromstärke nicht ändern.

Activity 6 Calculations

- a** $I = 10V / 100\Omega = 0,1A$
- b** $V = 250mA \cdot 96\Omega = 24V$
- c** $R = 12V / 50mA = 240\Omega$
- d** $I = 4.5V / 2.5\Omega = 1,8A$
- e** $V = 1k\Omega \cdot 4A = 4000V$
- f** $R = 9.3V / 150mA = 62\Omega$
- g** $P = 12V \cdot 400mA = 4,8W$
- h** $I = 9kW / 400V = 22.5A$

Activity 7 Chain exercise

Beispiel:

A: What is 4 times 3?

B: 4 times 3 equals 12. What is 20 divided by 5?

C: ...

Activity 8 Listening

	Name	Date and place of birth	Date and place of death	Profession	Inventions	Unit
1	James Watt	January 1736 Greenock /Scotland	25.8.1819 Heathfield	engineer and scientist	improvement of steam engines	Watt
2	Alessandro Volta	18.02.1745 Como/ North Italy	05.03.1827 Como	physicist	battery	Volt
3	André Marie Ampère	20.01.1775 Lyon / France	at the age of 61 Marseille	mathematician and physicist	electrodynamics / magnetism	Ampere



Listening Chapter 2 – Activity 8

1) In January 1736, James Watt was born in Greenock, a small town in Western Scotland. Mr. Watt worked as an engineer and scientist and his most important work resulted in the improvement of steam engines. He discovered how to operate them much more efficiently. He died on 25 August 1819 at the age of 83 in Heathfield, England. The unit of power, the watt, was named after him.

2) Alessandro Volta was a famous Italian. He was born in Como, in northern Italy, on 18 February 1745. His parents wanted him to study law, but he was more interested in electricity. As a physicist, he experimented a lot and one day invented the battery. This was around the year 1800.

As he had also found a way to measure voltage, the unit of voltage, the volt, was named after him. Mr. Volta died on 5 March 1827 in Como, his birthplace.

3) The unit of current also has a famous namesake: André-Marie Ampère. He was born in Lyon, which is a city in France, on 20 January 1775. At the age of 61, he died of pneumonia in Marseille in the South of France. His grave is located in Paris where it can be visited nowadays. During his lifetime, Ampère worked as a mathematician and physicist and is considered one of the founders of electrodynamics. He discovered that electricity is the origin of magnetism. Ampère explained the terms voltage and current and defined the direction of electrical current and invented a device to measure electrical current. The SI unit for measuring current, the ampere, now bears his famous name.

3 Resistor and Resistance

Activity 1 Text comprehension

- a resistor: Widerstand (Bauelement), resistance: Widerstandswert
- b Eine dünne Schicht aus Kohlenstoff oder Metall wird auf einer Keramikplatte aufgebracht. Die Form und Länge der Schicht bestimmt den Widerstandswert.
- c Die Nennleistung hängt davon ab, wieviel Wärme der Widerstand abgeben kann. Große Leistung benötigt meistens auch eine große Bauart. Metallschichtwiderstände haben oft eine höhere Leistung als Kohleschichtwiderstände.

Activity 2 True or false

- a True.
- b True.
- c False, the characteristic properties are resistance power-rating and tolerance.
- d True.
- e False, metal film resistors have a higher power-rating than carbon film resistors.
- f True
- g False, resistors are used as current control devices.

Activity 3 Study the picture

The picture shows different types and sizes of resistors. In the bottom left corner there are three metal glaze resistors. They look like black rectangles. In the top left corner, you can see the carbon-film type of resistor in different sizes. They all are light grey with different colour bands. In the middle you can see chip resistors which look like black rectangles, too. On the right side you can see different kinds of metal-film resistors. Most of them are dark grey with colour bands.

Activity 4 Find the words

- 1 resistor
- 2 combine
- 3 resistance
- 4 identical
- 5 double
- 6 less
- 7 decrease
- 8 connect
- 9 fifty
- 10 another
- 11 thirty

Activity 5 Colour codes

- a**
- 1 $68 \cdot 10^4 \rightarrow 680 \text{ k}\Omega, 5\%$
 - 2 $35 \cdot 10^2 \rightarrow 3,5 \text{ k}\Omega, 1\%$
 - 3 $47 \cdot 10^3 \rightarrow 47 \text{ k}\Omega, 5\%$
 - 4 $16 \cdot 1 \rightarrow 16 \Omega, 1\%$
 - 5 $91 \cdot 10 \rightarrow 910 \Omega, 0\%$
 - 6 $33 \cdot 10^6 \rightarrow 33 \text{ M}\Omega, 0,5\%$
- b**
- 1 yellow/blue/brown/silver
 - 2 yellow/violet/blue/gold
 - 3 blue/grey/brown/brown
 - 4 orange/orange/brown/gold
 - 5 brown/red/red/green
 - 6 green/blue/brown/red

Activity 6 Comprehension

- a** Silver is the best metal conductor, but it is very expensive.
Copper is the second-best conductor. It is much cheaper than silver and it is used often.
Gold is the third best conductor. It has the advantage that it does not tarnish.
Aluminium has the lowest conductivity of the four metals, but it is very lightweight.
- b** Pure water insulates well. Dirty water is a weak conductor. Saltwater conducts well.
- c** Conductivity is the measure of how well a material conducts electricity. The symbols for electrical conductivity are gamma or kappa and it is measured in siemens per metre.

Activity 7 Translation

- a** A resistor reduces the current.
- b** The tolerance describes the maximum possible spread of the nominal value.
- c** The rated power of resistance must not be exceeded.
- d** The applied electrical power is transformed into heat by the resistance.
- e** A potentiometer is a variable resistor.
- f** Copper has a higher conductivity than gold.
- g** Silver has the disadvantage that it creates a non-conductive layer of oxide.
- h** The resistance of a cable depends on the length of the cable.

Activity 8 Comprehension

- a** Kohleschichtwiderstand
- b** Nennspannung = 250V, maximale Leistung = Nennleistung = 1,5W
- c** Nennwerte gelten für 70°C
- d** 1 Ohm bis 10 Megaohm in der Abstufung der E-24-Serie (1 – 1,1 – 1,2 – 1,3 – 1,5 ...)
- e** Abweichung $\pm 5\%$
- f** Laut Diagramm 40% der Nennleistung $\rightarrow 0,4 \times 1,5 \text{ W} = 0,6 \text{ W}$
- g** Zwischen -45°C und $+70^\circ\text{C}$

Activity 9 Listening comprehension

- a** Higher temperature means lower conductance (higher resistance).
- b** No energy is wasted from the conductors in the form of heat and you can build smaller devices.
- c** Superconductivity was discovered in 1911.
- d** High temperature superconductivity can be achieved at -73°C .
- e** You can find superconductors in large motors, generators and hospital equipment like MRI.
- f** The next step will be to build smaller and more efficient motors and generators.



(vel.plus/EL03)

Listening Chapter 3 – Activity 9

Sandra Solid and George Brannon

S: Hi guys and welcome to today's TecTalk radio show. I'm Sandra Solid and our special guest for today is Professor George Brannon from the Institute of Applied Physics in Dallas. We are going to talk about new developments in the world of superconductivity. Hello Professor Brannon and thank you for being here with us.

B: My pleasure.

S: Could you tell our listeners what superconductivity is all about?

B: Sure. Of course, you know that the term conductivity describes how well a material conducts electricity. A good conductor like copper has a relatively small resistance. But even this resistance is the cause of considerable power loss. As soon as a current flows through a cable the cable heats up because of its resistance. If you think of all the heat sinks and fans that you need

to dissipate the heat in a computer you know what I mean. Wouldn't it be great to have no power loss at all? We could build smaller devices and save a lot of money because no energy would be wasted in the form of heat anymore.

S: That would be great but how can this be done?

B: You know that the resistance of a material like copper depends on the temperature. Higher temperature means greater resistance and greater power loss. If you cool copper down the resistance decreases. In 1911 it was discovered that with certain materials the resistance disappears altogether at a temperature of -263°C . This effect is called superconductivity.

S: But how can you cool anything down to -263°C ?

B: That's the main problem. In our lab we use liquid helium but obviously this won't work for devices like your home PC!

S: And where is the good news then?

B: The good news is that the temperature for superconductivity naturally depends on the material used. In 1986 ceramic materials were discovered that are super-

conductive at -183°C and some time ago we reached -73°C for high pressure hydrogen, which is quite a big step! We call it high-temperature superconductivity.

S: This sounds promising. But are there already practical applications for superconductivity?

B: Oh yes, there are! Of course cooling devices down to such temperatures is kind of expensive. It makes sense when high currents are used and therefore substantial losses occur when conventional technology is used. Today you can find superconductors in large motors, generators and hospital equipment like MRI machines.

S: And what do you think, when will the superconductive PC be available for home use?

B: Well ... I dare not give a deadline for that. But I know that we can expect a rapid development of superconductive technology in the years to come. The next step will be to build motors and generators which are smaller and much more efficient.

S: Thank you, Professor Brannon, for taking the time to talk with us here at TecTalk.

B: Thank you for inviting me.

4 Measuring Basics

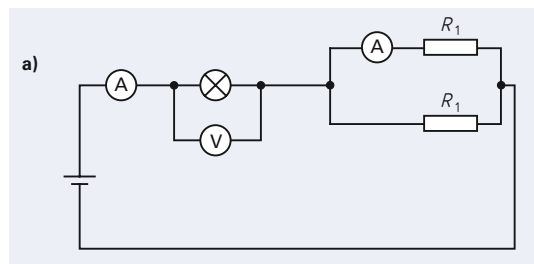
Activity 1 True or false?

- a** True.
- b** False. *Analogue* multimeters indicate the measured value using a pointer over a scale.
- c** True
- d** False. You can usually replace the fuse after opening the battery compartment at the back of the device
- e** True.
- f** False. Most multimeters *cannot measure frequency*.
- g** False. If you want to measure the voltage across a load, the meter must be connected *in parallel*.
- h** True.

Activity 2 Label the picture

- 1** test probe
- 2** test lead
- 3** socket
- 4** housing / case
- 5** range switch
- 6** scale
- 7** display

Activity 3 Listening



- b** Ammeter at R_1 : $R_1 = R_2 \rightarrow I_1 = I_2 = 200 \text{ mA}$
 Ammeter at lamp in series $\rightarrow I = 2 \times 200 \text{ mA} = 400 \text{ mA}$
 Voltmeter: resistance of lamp = resistance of R_1 and R_2 in parallel $\rightarrow U = 12 \text{ V} / 2 = 6 \text{ V}$



(vel.plus/EL04)



Listening Chapter 4 – Activity 3

- a)** Please make a sketch of the following circuit: Firstly, there is a battery. A lightbulb is connected in series to the battery. There are two resistors that are connected in parallel to each other. There are two ammeters and one voltmeter in the circuit. The first ammeter is used to measure the current that flows through resistor R_1 . The second one displays the current that flows through the lamp. The voltmeter measures the voltage across the lamp.
- b)** Figure out what the three meters in the circuit show if the following values are given: The battery supplies the circuit with a voltage of 12 volts. The current through R_2 is 200 milliamperes; the two resistors have the same value. The resistance of the light bulb is half as high as that of R_1 .

Activity 4 Units and prefixes

- a** $200 \text{ mA} = 0.2 \text{ A}$
b $5 \mu\text{m} = 0.005 \text{ mm}$
c $1 \text{ kW} = 0.001 \text{ MW}$
d $2 \text{ TB} = 2000 \text{ GB}$
e $300 \text{ pF} = 0.3 \text{ nF}$
f $5 \text{ kV} = 5000 \text{ V}$
g $23 \text{ M}\Omega = 23000 \text{ k}\Omega$

Activity 5 Mediation

First you must set the multimeter to the right measuring range.
 Turn off the power at the object being measured.
 Connect the measuring leads to the sockets of the multimeter.
 Place the test probes on the component that you want to measure.
 Read the value on the display. If you see an error message on the display you may have to switch to a higher measuring range.

Activity 6 Data sheet comprehension

a analogue:

- LCD scale with pointer
- scale length of 55 mm in all ranges
- scale division 0 ... +/- 60
- automatic polarity switching
- overflow is indicated by a triangle
- measuring rate: 20 measurements per second

digital:

- display with 7-segment characters, height: 15 mm
- display can indicate 6000 steps
- overflow is indicated by "O.L."
- wrong polarity is indicated by "-"
- measuring rate: 2 measurements per second

b

- **analogue:** faster response time
- **digital:** easier to read

c

- digital mode for normal measurements of DC- or RMS – values
- analogue mode to measure quantities with switching polarity or fast changing values

Activity 7 Measuring faults

- Operating error: This is always caused by the user. For example, when you connect the voltmeter in series.
- Error caused by ambient influences: This can be caused by unfavourable environmental conditions. If you work in an area with strong magnetic fields, it can cause the measuring instrument to malfunction.
- Reading error/parallax error: When you read a false value from the display of an analogue multimeter. If you look at the pointer scale from the side slightly, for example, you will read an incorrect value.

- Error caused by inaccuracy of the meter: Accuracy and resolution of multimeters are limited. You find information on this error in the manual
- Error caused by faulty calibration: The calibration is normally undertaken by the manufacturer of the multimeter. Calibration is an adjustment of the instrument to show precise values.

Activity 8 Mediation

- a**
- Messbereich bis 600 mA: FF 1,6 A / 1000 V (FF = superflink), Schaltvermögen 10 kA
 - Messbereich bis 10 A: FF 10 A / 1000 V, Schaltvermögen 30 kA
- b**
- Temperatur: –10 bis +50 Grad Celsius
 - Relative Luftfeuchte: 45 bis 75 %
 - bis in 2000 m Höhe

- c**
- 350 Gramm mit Batterie
 - Größe: 84 mm × 195 mm × 35 mm

- d**
- Multimeter
 - Gummi-Schutzhülle
 - 2 AA-Batterien
 - ein Satz Messleitungen
 - Kalibrierschein
 - Bedienungsanleitung (Kurzform)

- e**
- Temperatursensor
 - Zangenstromwandler für AC (~"Aufsteck-Trafo")
 - Tragetaschen in zwei Größen (für Gerät und Zubehör)
 - Hartschalenkoffer in zwei Größen
 - Satz Sicherungen (10 Stück, 1,6 A)
 - Satz Sicherungen (10 Stück, 10 A)

5 Electrical Safety

Activity 1 Text comprehension

- a** An electric shock is an injury caused by an electric current flowing through the human body.
- b** Electricity is conducted by most fluids. As the human body contains lots of fluids it is a good conductor.
- c** The muscles in the human body are controlled by electric pulses from the brain.
If you touch a live wire the current will be greater than the electric pulses from the brain. The brain is then unable to control the muscles or the heart.
- d** burn, muscle cramps, ventricular fibrillation, cardiac arrests
- e** The severity depends on the kind of current (AC or DC), the frequency, the size of the contact area, the duration of contact, the path the current takes and the health status and age of the person.

Activity 2 Matching exercise

- a** a – 3
b – 5
c – 2
d – 1
e – 4
- b**
- a** You have to disconnect from the mains to avoid getting an electric shock while working.
- b** You should secure against reconnection to prevent somebody else switching on power while you work.
- c** You should verify with a measuring instrument that there is no voltage because you may have disconnected the wrong circuit.
- d** This is only necessary in circuits over 1000 V to make sure there is no harmful potential difference.
- e** This is in case you are working on an installation that is still partially connected to the mains.

Activity 3 Dialogue

(Lösung beispielhaft, andere Lösungen sind möglich)

- You:** Hi John!
- Intern:** Hi, what's up?
- You:** Today, I would like to explain to you what safety rules we should follow as electricians.
- Intern:** Great, that sounds really important.
- You:** Well, yes, first of all before you start working on electrical equipment you have to turn off the electricity by disconnecting the circuit from the mains.
- Intern:** But how do I disconnect a lamp circuit? By turning the light off?
- You:** You turn off the circuit breaker in that circuit and secure it against reconnection e.g. with adhesive tape or a sign.
- Intern:** And then I should verify that the system is dead, right?
- You:** Right. You use a voltage tester for this, but make sure that the tester works by using it on a working circuit first.
- Intern:** What about earthing and short circuiting?
- You:** You don't have to do that in circuits with a voltage below 1000V. Also, the protection from adjacent live parts only applies in certain special situations. For example, in an installation where you are not allowed to disconnect every circuit.

Activity 4 Mediation

- Besucher müssen sich im Büro melden.
- Alle Unfälle sind sofort zu melden.
- Schutzhelme, Warnwesten und Sicherheitsschuhe müssen getragen werden.
- Eltern sollen ihre Kinder über die Gefahren auf der Baustelle aufklären.
- Unbefugtes Betreten ist verboten.
- Tiefe Ausschachtungen (Erdarbeiten).
- Schwere Maschinen werden eingesetzt.
- Kinder dürfen hier nicht spielen.

Activity 5 Safety signs

- a**
- 1 location of the first aid kit
 - 2 no smoking
 - 3 high voltage
 - 4 emergency exit
 - 5 wear safety glasses
 - 6 location of fire extinguisher
 - 7 poisonous substance
 - 8 wear safety gloves
- b**
- 1, 4 and 6 in any public building
 - 2 on sites with explosive materials
 - 3 on high-voltage installations like transformers
 - 5 and 8 on sites with heavy machinery
 - 7 on sites of the chemical industry
- c**
- Blue signs tell us what we should do, for example wear a helmet.
 - Red signs tell us what we must not do.
 - Yellow signs warn of a certain danger.
 - Green signs indicate escape routes in the event of accident or danger.

Activity 6 Look at the pictures

Lösungen individuell unterschiedlich.

Beispiel: Picture 2

The picture shows part of the open case of an unknown appliance. The case is made of grey plastic. There are ventilation slots visible on the right and on the left, so it may be some kind of fan or heating appliance. In the top left corner, you can see the white power cord attached on the inside of the case. In the bottom left corner there are two blue wires connected by a wire nut. Several red wires run from the left to the centre of the picture where they are connected to some kind of switch made from black plastic. You see the fingers of a person holding a pair of pliers to the contacts or terminals of the switch. This is causing a big yellow-red spark or arc at the contacts.

The person is obviously causing a short circuit because he forgot to turn off electricity.

Activity 7 Listening

- Jenny Miller ruft an.
- Es ist auf einer Baustelle passiert. Die Adresse ist Bridge Street 20b in Manchester.
- Ihr Kollege hat einen Stromschlag bekommen. Er war dabei, Schlitzte zu stemmen, als er eine Leitung traf. Dabei ist er von der Leiter gefallen.
- Nur eine Person ist betroffen.
- Er atmet und ist bewusstlos.
- Der andere Kollege soll bei dem Verletzten bleiben.
- Jenny soll die Tür öffnen und draußen auf die Rettungssanitäter warten, um ihnen den Weg zu zeigen.



Listening Chapter 5 – Activity 7

Phone call

male operator – M1

male caller – M2

female who answers the phone – F

F: [speaking to herself] Oh, dear! I need an ambulance! What can I do? Wait, UK emergency call is 999 ... let's see ... [ring, ring, ...]

M1: Hello, emergency services, John speaking. Which emergency service do you need? Fire brigade, police, or ambulance?

F: Ehm, well, I need an ambulance! Quickly! My colleague needs help!

M1: I will put you through to the ambulance service, please stay calm it will only be one second.

F: Thank you.

M2: Hello, ambulance service, this is Jim speaking. What's your name please?

F: My name is Jenny, Jenny Miller.

M2: Ok, Jenny, please tell me where you are calling from.

F: Ehm, we are on a building site. My colleague has had an electric shock ... we are rewiring the house and ...

M2: Right, stay calm please – do you know the address of the house that you are working in?

F: Yes, well, ehm, it's in Bridge Street, in downtown Manchester, right where the church is ...

M2: I've got that, Manchester, Bridge Street, near the church. Do you know the house number?

F: Yes, it's 20, no – wait it's actually 20b.

M2: Right, the ambulance is on its way, now please tell me what exactly has happened.

F: We were rewiring this old house and my colleague was cutting grooves in one of the walls. He hit a live wire and he fell off the ladder. I think he hurt himself badly.

M2: Is he breathing?

F: Yes, I think he is, I put him in the recovery position, but he is unconscious!

M2: Is anybody else with you?

F: Yes, my other colleague is also here, he is now looking after him.

M2: Very good, he should stay where he is, and you should go outside to show the paramedics where to go. Open the door for them and make sure they don't lose time looking for the place. They will be there very soon. Hurry up!

F: Ok, on my way, thank you!

6 Installation Basics

Activity 1 Mediation

In neuen Gebäuden wird die Elektroinstallation unter Putz ausgeführt. Die Leitungen werden meist in Leerrohren verlegt, die von Putz überdeckt werden. Die Leitungen sollten senkrecht mit Abständen von 15 cm zu Türen und Fenstern oder waagrecht in 30 cm Abstand zu Boden oder Decke verlaufen.

Lichtschalter sollten in einer Höhe von 105 cm und Steckdosen in 30 cm Höhe über dem Boden montiert werden.

Aufputz-Montage wird auf Betonwänden in Kellern und in Garagen oder im Außenbereich angewendet. Die Rohre werden mit Schellen an der Wand befestigt. Der Schellenabstand sollte 25 cm betragen. Der Abstand

zwischen einer Schelle und einem Lichtschalter oder einer Abzweigdose sollte 8 cm betragen.

In der Hausverdrahtung sind nur starre Leitungen erlaubt- flexible Leitungen sind verboten.

Die Standardleitung enthält 3 isolierte Adern: Phase (L), Neutralleiter (N) und Schutzleiter (PE).

Heutzutage werden in Abzweigdosen Steckverbinder verwendet. Die älteren Schraubklemmen werden kaum noch verwendet.

In Deutschland ist ein 3-Phasennetz mit 400V/230V und 50Hz der Standard.

In Großbritannien ist für Häuser eine Versorgung mit einer Phase 230V/50Hz üblich.

In den USA werden in Häusern dagegen 2 Phasen 240V/120V bei 60 Hz verwendet.

Activity 2 Working with words

- a outdoor wiring
- b flush mounted installation
- c stranded wire
- d spacing
- e screw terminals
- f conduits
- g wall socket
- h junction box
- i surface mounted installation
- j mains supply

Activity 3 Name the parts

- a
 - 1 main power cable – Hauptleitung
 - 2 service cutout – Hausanschlusskasten (HAK)
 - 3 electricity meter – Elektrizitätszähler (Stromzähler)
 - 4 consumer unit (main fuse box) – Stromkreisverteiler (Verteilung)
 - 5 Miniature circuit breakers (MCB) – Leitungsschutzschalter (LS-Schalter)
 - 6 equipotential bonding bar- Haupterdungsschiene
 - 7 cold water supply (with water meter) – Kaltwasserversorgung (mit Wasseruhr)
 - 8 gas pipe- Gasleitung
 - 9 earth clamp – Erdungsschelle
 - 10 cold and hot water pipes – Kalt- und Warmwasserleitung

b

- 1 The service cutout contains the main fuse.
- 2 True.
- 3 The electricity meter is connected to the consumer unit by four or five wires.
- 4 All protective conductors must be connected to the equipotential bonding bar.
- 5 True.
- 6 If you want to replace the electricity meter you can take out a fuse between the meter and the service cutout.
- 7 True.
- 8 The public electricity network ends in your service cutout.

Activity 4 How to install a wall socket

(Lösung beispielhaft)

First you have to connect the wires to the terminals of the socket. Use a wire stripper if necessary, to strip off the insulation. Push the wires firmly into the terminals of the socket. Connect the brown and the blue wire and don't forget to connect the PE-wire correctly.

Then put the socket into the wall and tighten the inner screws. Once the socket is mounted securely on the wall you can put the frame on and the faceplate. Fix it by tightening the central screw on the faceplate. You may have to align the frame while tightening the faceplate screw.

Activity 5 Translation

- a All houses in Germany are connected to a 3-phase mains supply.
- b For a flush- mounted installation you need conduits but no clamps.
- c The spacing between a clamp and a junction box may not exceed 8 cm.
- d The service cutout is connected to the electricity meter by a cable with 5 wires.
- e You must not use stranded wire for the connection of wall sockets.
- f The protective conductor is green-yellow striped in every installation.
- g A surface-mounted installation is often used for outdoor wiring.
- h The electricity meter is sealed and should not be opened, even by the electrician.

Activity 6 Listening comprehension

- a** You should only work on electric installations in your house if you know exactly what you are doing. Always switch off the power before working.
- b** The wiring of your electrical supplier's meter.
- c** The meter measures the electrical energy and not the power.
- d** Power equals voltage multiplied by current. To measure electrical energy, you have to add the element of time. Electrical energy is calculated with the formula for electrical work: $W = P \cdot t$.
- e** Mechanical meters use two conductor coils that create magnetic fields. One coil is affected by the current and the other by the voltage.
- f** A normal magnet is too weak to slow down the meter and a very strong magnet will very likely damage the meter. The newer digital electric meters are highly accurate and are not affected by magnetic fields.



Listening Chapter 6 – Activity 6

Linda Stock

Hi everybody, this is Linda Stock from *homehandyman* – the do-it-yourself radio show.

Today we are going to talk about electricity. As I have mentioned before, you should only work on electric installations in your house if you know exactly what you are doing. Always switch off the power before starting work. Messing around with 230 volts can be a deadly experience. But even if you are an experienced electrician there are parts of your electrical installation which you shouldn't modify in any way. I am talking about the wiring of your electrical supplier's meter. Even though you shouldn't touch the wiring under any circumstances, it is still interesting to know what the electrical meter does. You might say: "Well, of course I know, it tells the utility company how much power I use each month" but this is wrong. The meter measures the electrical energy and not the power. Try to remember your physics from school: Power equals voltage multiplied by current and it is measured in watts. To measure electrical energy usage you have to add the element of time. Electrical energy is calculated with the formula for electrical work: $W = P \cdot t$, and is measured in kilowatt-hours.

For example, if you turn on a 50-watt light bulb for 10 hours, you will consume 50 watts times 10 hours = 0.5 kilowatt hours.

At an energy price of 30 cent per kilowatt hour you'd pay 15 cents for the light. This doesn't sound like a lot, but throughout the year it accumulates to a significant sum for an average household.

Now, how does a meter work?

The older mechanical meters use two conductor coils that create magnetic fields. One coil is affected by the current and the other one by the voltage. Rumour has it that you can influence a mechanical meter by holding a strong magnet close to the case. Fact is, a normal magnet is too weak to slow down the meter and a very strong magnet will very likely damage the meter. Then your supplier will certainly sue you because you interfered with his property. But don't even think about it - in all newer installations digital electric meters are used. They are highly accurate and cannot be altered by magnetic fields.

The best way to save on your electricity bill is to save energy. Turn off the light and don't let your TV run all day when you are not in the room.

So that's it for today. Thanks for listening and have a nice day!

Activity 7 Describing pictures

(Lösungen beispielhaft)

- a** In the middle of the picture you see a bearded man with a white helmet and a red plaid shirt. He looks like an electrician. He has a long grey cable wound over his shoulders and he holds coiled cable in his left hand. He looks a bit helpless scratching his head with his right hand.
In front of the man you see a tabletop where different tools and material for electrical installation are spread out. On the left you can see pliers and fuse holders. In the middle there is a screwdriver and insulating tape and on the right side you can see different sockets and a light bulb.
- b** He should try to look more confident.
He should put on his helmet straight.
He should remove the cable from his body and clean up the desk.
The tools and the material should be placed side by side on the desk in an orderly manner.

Activity 8 Electricity meter

- a Man kann zum zweiten Tarif wechseln, indem man 230Volt an die Klemmen E1–E2 anlegt.
- b Der N-Leiter muss immer angeschlossen werden.
- c Der Eigenverbrauch beträgt 0,5W pro Pfad und wird nicht gemessen oder angezeigt.

- d Die gesamte Wirkenergie je Tarif, die Wirkenergie der rücksetzbaren Speicher RS1 und RS2, sowie die Momentanwerte für Leistung, Spannung und Strom je Außenleiter.
- e „False“ wird bei fehlendem Außenleiter oder falscher Stromrichtung angezeigt.

7 Installation Material and Standards

Activity 1 Text comprehension

- a
 - nails – Nägel
 - screws – Schrauben
 - cable clips, clamps – Schellen
 - plaster – Gips, Mörtel
 - cable – Leitung, Kabel
 - conduit – Leerrohr
 - switch – Schalter
 - socket – Steckdose
 - safety devices – Schutzgeräte
- b Beispiele:
 - screw anchor/ rawplug – Dübel
 - wires – Einzeladern
 - junction box – Abzweigdose
 - in England/USA: wirenuts, screw terminals
 - in Deutschland Schraubklemmen / oder Steckklemmen (Wago)
- c Beispiele:
 - To fix a conduit to the wall you need clamps, rawplugs and screws.
 - We install safety devices to protect the cables from overheating.
 - We use plaster if we want to hide the cabling inside the wall (flush mounted installation).

operationen problematisch war. Ein Land nach dem anderen entschloss sich seitdem das metrische System einzuführen. Um weltweit Güter und Maschinen auszutauschen sind gemeinsame Standards sinnvoll. Das internationale Einheitensystem auf das man sich geeinigt hat wird SI-System genannt. Es basiert auf dem metrischen System. Das SI-System baut auf sieben Grundeinheiten auf, welche sich auf Naturkonstanten beziehen. Um die Zahlenwerte klein zu halten werden Einheiten-vorsätze benutzt.

b

Symbol	Name	Quantity
mol	mole	amount of substance
s	second	time
m	meter	length
K	kelvin	temperature
Kg	kilogram (kilogramme)	mass
A	ampere	electrical current
Cd	candela	light intensity

a

- 1 foot equals 30.48 cm, 1 foot equals 12 inch, (1 yard equals 3 feet (0.9 m))
- 1 mile equals 1.6 km, 1 mile equals 5280 feet
- 100 F equals 37,78 °C, the freezing point of water is 32 °F
- 1 pint (US) equals 0.47 l, 1 pint (UK) equals 0.57 l
- 1 gallon equals 8 pints
- 1 pound equals 0.45 kg, 1 stone equals 14 pounds

Activity 2 Units of measurement**a Beispiellösung:**

Das metrische System, das heutzutage in den meisten Ländern gebräuchlich ist, hat seinen Ursprung 1799 in Frankreich. Damals hatten viele Länder ihre eigenen Maßsysteme, was für internationalen Handel und Ko-