WEEK: 1 **DATE: _____**

Key word

- **short circuit** – when wires that should not touch do touch, and the electrical current takes a shorter path

Revise simple circuit components

In Grade 7 you investigated an electrical circuit like the one in Figure 5. It has a cell, a switch, connecting wires and a lamp.

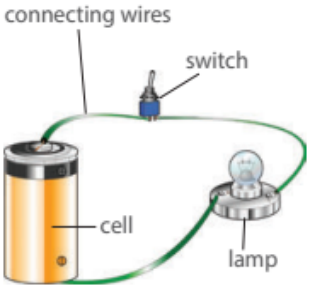


Figure 5 A simple circuit with a cell, switch, connecting wires and lamp

Electrical components and their accepted symbols

When you design a circuit, you also draw a diagram of the circuit to show others how to build it. Instead of using lifelike sketches, you use symbols for circuit components in circuit diagrams (look at Table 1). The symbols are internationally recognised, which means that any engineer in the world will understand your circuit diagram.

Table 1 Symbols used for electrical components

Component	Symbol	Component	Symbol
Cell		Lamp	
Switch		Electromagnet	
Connecting wire		Buzzer	

Figure 7 A circuit with a cell, electromagnet, connecting wires and a switch

Input, control (process) and output devices

Nearly every circuit has an input device, a control device and an output device. Look at the simple circuit shown in Figure 7 and take note of the following:

- A cell (electrochemical cell) is the source of energy for the circuit. The cell puts electrical energy into the circuit, so it can be called an input device.
- The switch is also an input device. You have a physical input into the circuit because by flicking the switch you make the circuit work.

Input devices

Generator

Output devices

Solar panel

12 V buzzer

6 V motor

OUTPUT DEVICE

- The lamp converts the electrical energy in the circuit and gives it out as light energy. So, the lamp is called an output device.

A heater is also an output device. Some components can function as input or control devices, for example a switch, and some function as control or output devices.

Control devices

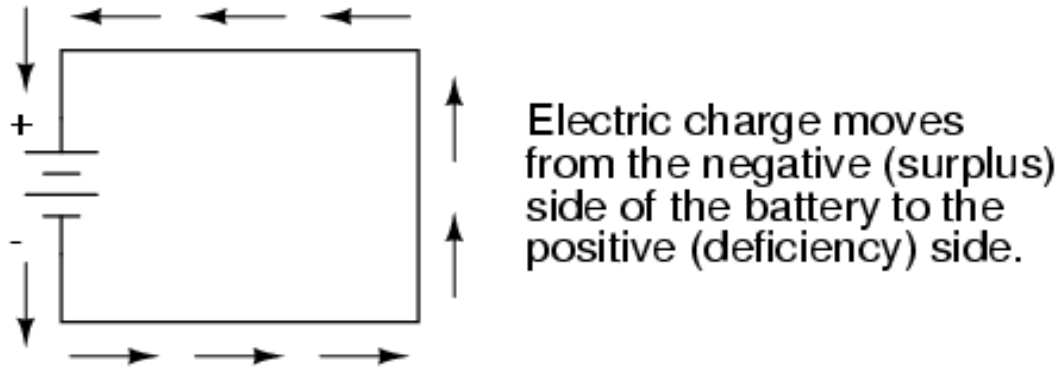
CONTROL DEVICE

- The **switch** is controls the flow of the current in a circuit.

CURRENT FLOW

We differentiate between **electron flow** and **conventional current flow**.
We designate charge flow according to the **actual motion of electrons in a circuit**. This is known as **electron flow**

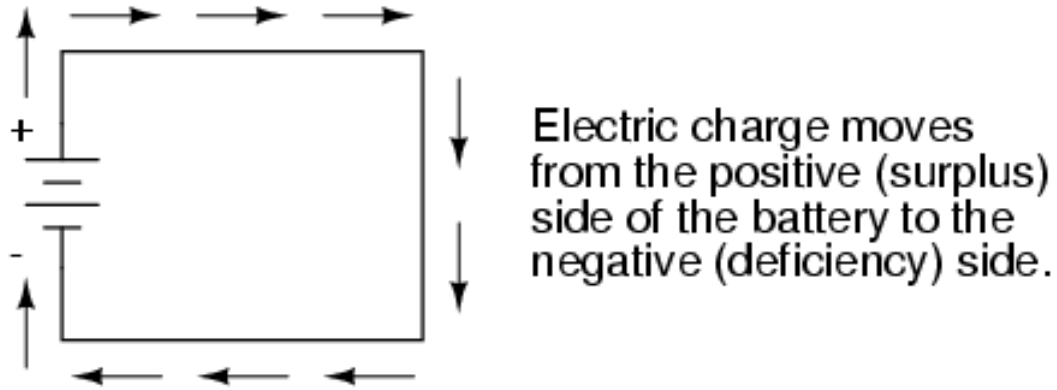
Electron flow notation



In **electron flow** notation, we follow the **actual** motion of electrons in the circuit, **from – to + in the external circuit.** This is also referred to as the flow of **negative charge**.

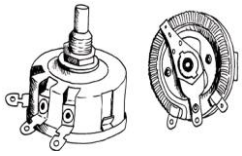
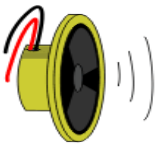
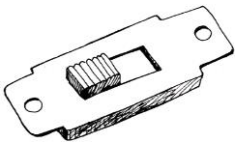
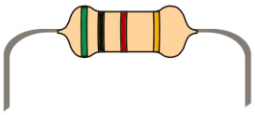
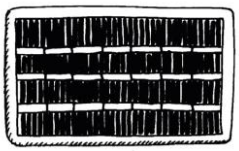
The **conventional flow** notation followed by most electrical engineers and illustrated in most engineering textbooks are **from + to – in the external circuit**. This is also referred to as the flow of **positive charge**.

Conventional flow notation



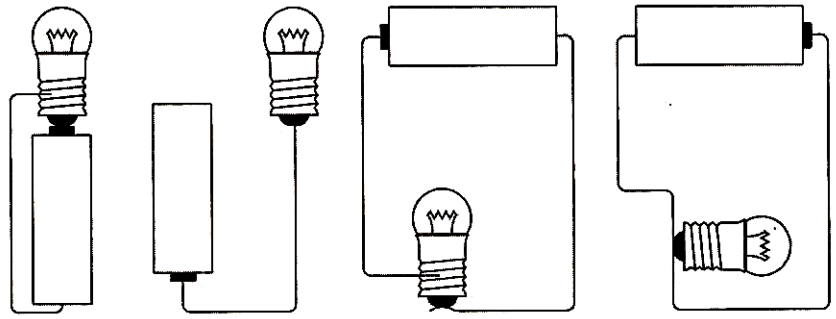
ACTIVITY 1

Complete the table below by the writing the name of the component, draw the symbol and indicate whether the component is an input/control or output device. (24)

	COMPONENT	NAME	SYMBOL	INPUT/CONTROL/OUTPUT
a)				
b)				
c)				
d)				
e)				
f)				
g)				
h)				

ACTIVITY 2

2.1. In the four drawings below, which of these four different ways of arranging leads form an electrical circuit that make the bulb light up? (1)

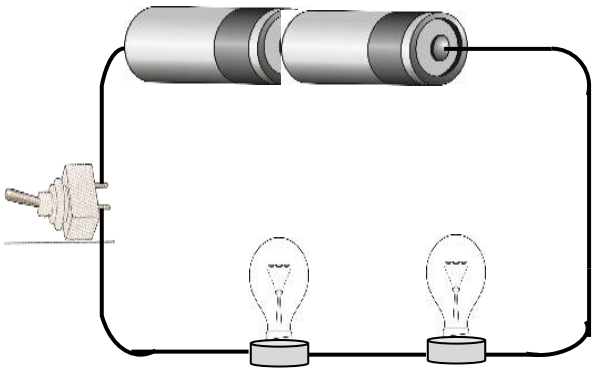


A B C D

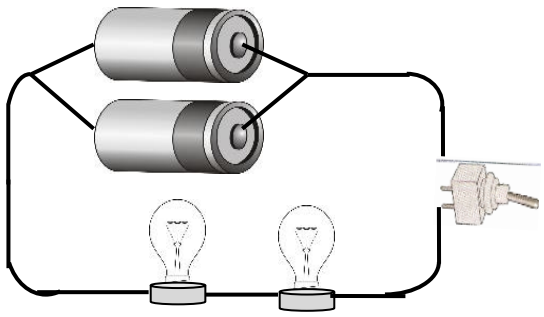
2.2. What do we call the arrangement in figure D? …….. (1)

2.3 Use the correct symbols to draw neat circuit diagrams for the given circuits below:

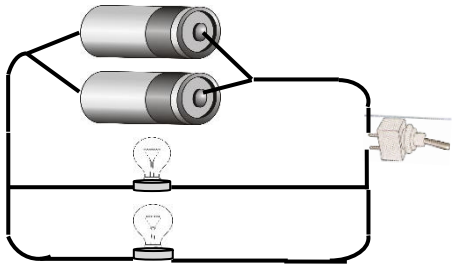
2.3.1 Two cells connected in series, two globes in series with a switch. (5)



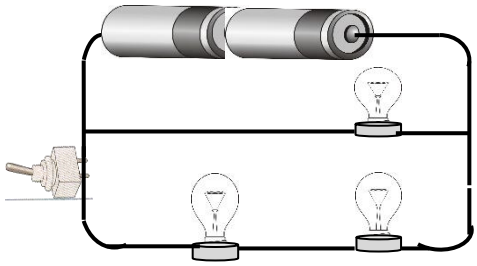
2.3.2 Two cells connected in parallel, two globes in series with a switch. (5)



2.3.3 Two cells in parallel, two globes in parallel and a switch. (5)

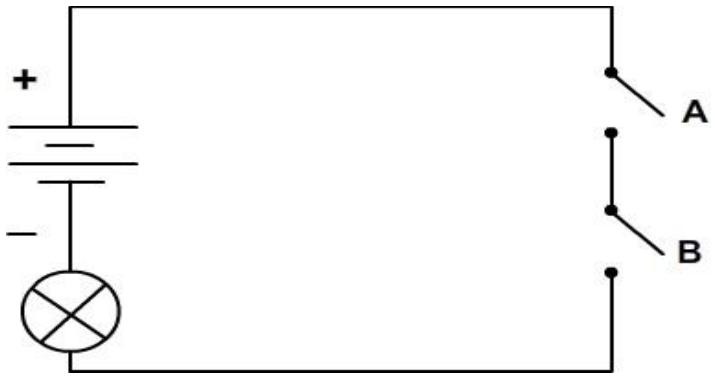
	

2.3.4 Two cells in series, three globes, two in parallel and the other one in series and a switch. (5)

PRACTICAL ACTIVITY 3

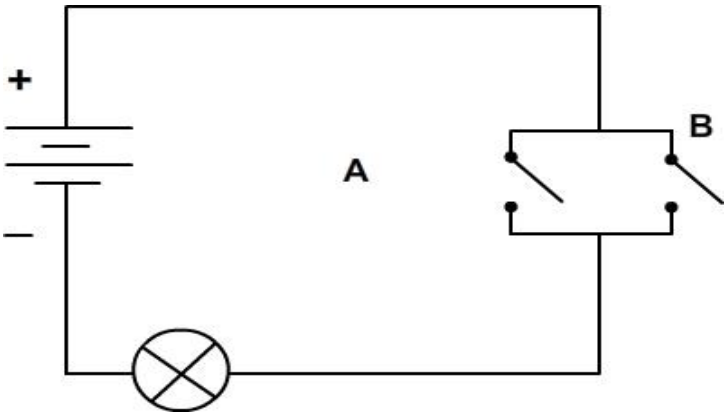
3.1 Build the series circuit below, using two switches to control one bulb. (4)



Complete the table below by using a tick ✓ to indicate the result:

Instructions	**Bulb LIGHTS UP**	**Bulb REMAINS OFF**
Switch OFF both “A” and “B”		
Switch ON “A” and switch OFF “B”		
Switch OFF “A” and switch ON “B”		
Switch ON both “A” and “B”		

3.2 Build the parallel circuit below, using two switches to control one bulb. (4)



Complete the table below by using a tick ✓ to indicate the result:

Instructions	**Bulb LIGHTS UP**	**Bulb REMAINS OFF**
Switch OFF both “A” and “B”		
Switch ON “A” and switch OFF “B”		
Switch OFF “A” and switch ON “B”		
Switch ON both “A” and “B”		

Correct connections

When you connect components in a circuit in Technology class, you must work carefully. A bad connection will not harm you, but your circuit might not work. You can use connectors such as crocodile connectors, strip connectors, nails in a block of wood, or screws and cup washers in a block of wood.

Poor connections and short circuits

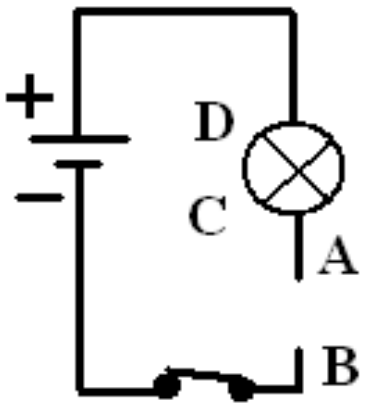
Poor connections can have bad results:

- A typical problem with circuits is poor connections. If the metal of a component is in contact with only the plastic of another component or connector, the connection will not work. Remember, connections must be metal-to-metal.
- If two bare wires that should not touch do touch, the current will take a shorter path. When this happens, the current gets larger, the wires get hot, and the cell or battery goes flat quickly. We call this a **short circuit**. It can cause a fire.

SHORT CIRCUITS: ADDITIONAL ACTIVITY / DEMONSTRATION

Objectives of the lesson

- **To investigate what a short circuit is**
- **To investigate electric shock**
- **To investigate safety when working with electricity**



WHAT IS A 'SHORT CIRCUIT'?

A 'short circuit' is when 2 bare live wires touch. In the simple electric circuit as the one below the light bulbs acts like a resistor and slows the flow of electric current.

If there is no resistor or other electrical components that act like resistors to slow the flow of electric current, too much current may flow through the circuit and damage the components or wires. When too much current (surge) flows through a component it results in the generation of heat that can melt the conductive path through which the electrons are flowing. This is known as a 'short circuit,' and it is the reason fuses or circuit breakers are often included in a circuit.

TO DO

Build a simple electrical circuit as shown above to show what happens in a short circuit

1. Connect a strand of fine steel wool across A and B in the circuit above.
2. **Turn the switch to the on position.**
3. **What happens to the bulb?**

_____

_____

4. With the piece of steel wool still in place, connect a piece of bare wire across the bulb (C and D).
5. What happens and why?

_____

_____

CONCLUSION

6. You will note that the fuse or steel wool will burn if a short circuit is connected across the bulb, which is due to the massive increase in current.

7. If a fuse is not used in a circuit and a short circuit takes place, what may happen?

_____

_____

8. Which component is built into household appliances to protect the circuit?

_____

_____

9. What should a first check be if a household appliance is not working?

_____

_____

WEEK 2 **DATE:** _____

ENERGY IN RURAL AREAS AND INFORMAL SETTLEMENTS

Most energy that is used in rural homes and in informal settlements is used **for heating, lighting, and cooking**.

THE *SOURCES* OF ENERGY:

- **wood,**
- **coal,**
- **paraffin,**
- **liquid petroleum gas (LPG)**
- **candles** for light
- **solar energy** is also used in some areas.

Key words

- **bio-fuel** – a natural renewable fuel that can be burnt, such as wood or cow dung
- **ethical issue** – a subject that has a right approach and a wrong approach

Figure 4 Many people use bio-fuels and fossil fuels as sources of energy.

CASE STUDY ON ILLEGAL ELECTRICITY CONNECTIONS & THE DANGERS AROUND IT

An illegal electricity connection is made when a person attaches their home's electrical circuit to the national grid without a meter. This is done without the consent or knowledge of Eskom. Eskom cannot monitor the electricity consumption and so the electricity is being stolen as these consumers do not pay for the electricity.

Some people make money by supplying illegal connections and others have no legal way to access electricity so they resort to illegal connections. Others have access to legal electricity but prefer not to have to pay for it. Not only are these types of electrical connections illegal and considered energy theft, but they are also extremely dangerous, as you will see in the next activity.

Electricity theft is illegal and extremely dangerous due to the insecure connections and fire risks.

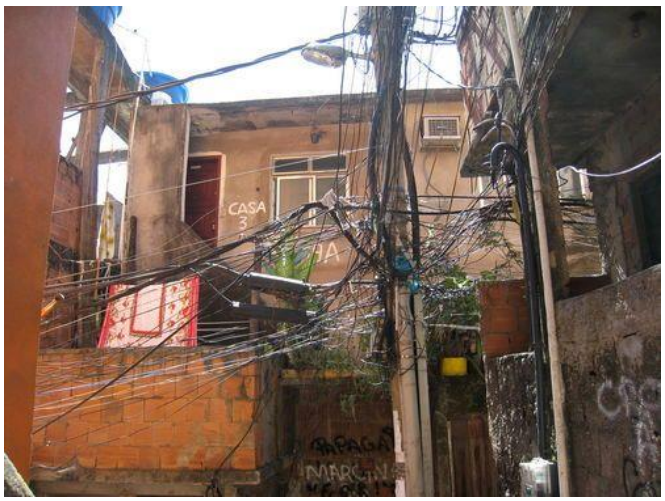
ACTIVITY 4 DATE: _____

INSTRUCTIONS

1. Read the following newspaper article and answer the questions that follow.

DOORNBACH INFORMAL SETTLEMENT CELEBRATES ELECTRICITY PROVISION

West Cape News, July 2012



There was much celebration in Doornbach, an informal settlement just outside of Cape Town, when the city switched on about 200 new electrical connections over the period of a few months in 2012. The illegal electricity connections had previously been the only supply of electricity to the area.

Authorities often encounter fierce opposition when trying to cut down illegal electricity connections in informal settlements. But the Doornbach residents immediately took it upon themselves to cut down the massive web of illegal wires in response to finally receiving formal, legal electricity provision.

Besides the mass of wires running through the informal settlement, many of the wires had been strung across Potsdam Road, the main road running through. This was **extremely dangerous as the wires hung incredibly low and would often catch on trucks passing through and snap**. **Fire threats and electrical shocks to passers-by and vehicles was also a safety concern**. The use of legal electricity will also help to prevent shack fires as residents will rely less on candles and paraffin stoves.

A fifty-two-year-old Doornbach resident, celebrating the end of illegal connections in the settlement, said that she had lived there for 18 years and never received any municipal services from the city. The reason being that they had originally settled on privately owned land, which meant that the City could not, in terms of National legislation, install services on privately owned land. However, the city bought the land in May 2011, and Eskom could therefore begin the process of providing electricity to households in Doornbach. The fifty-two-year-old was extremely excited about being able to use an electric iron and installing a refrigerator.

As a symbolic gesture, the residents took it upon themselves to remove the illegal wires. Many of the youth climbed up the dangerous makeshift poles to collect the wire which they would then sell to scrap yards. Not everyone was celebrating the switching on legal electricity connections in Doornbach. Many residents in neighbouring settlements, living in formal housing, were making money by selling and supplying electricity illegally to Doornbach. Street lighting has also been installed in Doornbach and it is hoped this will help to reduce the crime rate.

Lastly, the City of Cape Town extended their sincere thanks to the community of Doornbach, as without their support, involvement, and cooperation, such a project would not have been possible.

QUESTIONS

4.1 What is an informal settlement?

_____

_____

4.2 After reading this article, what do you think is the main reason that the people of Doornbach originally set up illegal connections?

_____

_____

4.3 Why is it dangerous to climb the makeshift electricity poles?

_____

_____

4.4 List FOUR of the physical dangers of the illegal connections in Doornbach?

_____

_____

_____

_____

4.5 Aside from the physical dangers associated with illegal electrical connections, why else are they illegal? Give ONE other disadvantage of illegal electrical connections.

_____

_____

_____

SUMMARY

- Electricity can be dangerous and so we need safety devices such as fuses, circuit breakers and earth leakages to reduce risk.
- A fuse is a safety device with an incredibly low resistance wire, designed to melt if it experiences a large enough current. This breaks the circuit and protects the appliance, as well as preventing a fire hazard.
- A circuit breaker is like a fuse but acts as a switch which breaks the circuit in response to an electrical fault or overload. It can be reset.
- Many electrical appliances with a metal casing have an earth wire attached to prevent electric shocks if there is a short circuit.
- A three-pin plug has three wires: a brown live wire, a blue neutral wire, and a green and yellow striped earth wire.
- The earth wire has an incredibly low resistance and is connected through the plug socket to the earth leakage system of the house, and into the ground.
- A plug must be connected properly to make sure that it is safe to use.
- Illegal electricity connections are both dangerous and illegal. It is a crime to steal electricity.

ACTIVITY 5: CLASS DISCUSSION & REPORT ON ENERGY

DATE: _____

READ THE INFORMATION BELOW THEN FOLLOW THE INSTRUCTIONS

Key word

- **equitable** – fair and equal

A fair share of electricity for all

In South Africa, electricity is supplied by a company called Eskom to everyone who is connected to the national grid. However, electricity is sometimes in short supply, so Eskom must ensure that everyone gets their fair share. Therefore, electricity must be shared **equitably**, or fairly. Even so, some activities use more electricity than others. For example, industry needs more electricity than agriculture. Industry needs enough reliable electricity to support South Africa's economy. This is important because industry makes goods that we need, employs millions of people and can create new jobs. Hospitals and other essential services also need a reliable source of electricity. Equitable sharing also means that poor and rich people should get electricity, even if they use different amounts.

Energy to light offices and sport stadiums

Energy to irrigate crops

Energy to run industry

Electricity is used in the six economic sectors in different ways:

- In towns and homes: for lighting, cooking and heating
- Commercial: for lighting and heating in shops and offices
- Industry: to manufacture goods that we need
- Mining: to light underground tunnels and for heavy machinery to extract minerals out of the ground. Electricity is also needed to turn ore into metal
- Agriculture: to run irrigation pumps and to keep food cold
- Transport: to run most types of trains.

What do you think would happen if there was no electricity? Sometimes this does happen, when power stations run out of coal, or when Koeberg nuclear power station shuts down. This causes 'blackouts', or periods of darkness. The results are serious: factories, shops, offices, restaurants and schools cannot function properly. People may lose money and jobs.

Figure 7 Electricity is used in all sectors of the economy.

INDUSTRY, SCHOOLS AND HOMES NEED POWER

A blackout, or 'rolling power-sharing,' occurs when electricity is shared by diverting it to different towns and cities in turn. Unfortunately, this means that some people, schools, and businesses do not get electricity when they need it. Part of this problem occurs because we waste electricity and use more than we need. We only realise this when electricity is unavailable. So, then what happens?

At schools, a learner might not finish a computer project on time, or the classrooms may be too dark. In factories, workers may not be able to finish an expensive manufacturing process. If this happens often enough, companies can go bankrupt and people can lose their jobs.

In many homes, electricity has become almost essential for everyday living. Although every person should have access to an equitable share of electricity, it must be used sparingly.

Source: Platinum, Grade 8 (page 170)

INSTRUCTIONS

5.1 HAVE A *CLASS DISCUSSION* ON THE ABOVE-MENTIONED TOPICS

- How does the availability of electricity influence the type off appliances people use in their households? Do people in households that do not have electricity have the same kind of appliances as people who do have electricity?
- How are rural and informal settlements disadvantaged if they do not have access to electricity?
-

5.2 WRITE A *REPORT* ON ONE OF THE TOPICS IN THE PROVIDED SPACE BELOW

GUIDELINES FOR WRITING A REPORT

A report presents information in a way that makes it easy to understand. A report should describe what things are like now or what they were like in the past. Follow these steps to draft a report:

A. **Gather the information for the report:**
   • observe, listen, and read
   • record information and facts, and make notes about these
   • organise the information and facts into sections and topics.

B. **Write a draft report:**
- beginning: Briefly describe what the report is about.
- middle: Outline three main sections and include three points in each section.
- end: Outline a summary, conclusion, advice, or recommendations.

C. **Write the final report:**
- the report should be factual, so avoid dramatic descriptions. For example, do not use words such as 'incredible', 'cool', 'fantastic', 'awesome' or 'brilliant'.
- write in the present tense or in the past tense, but not both.
- write in the third person; for example, 'He/she said the electricity would be on tomorrow', and not 'I think the electricity will be on- tomorrow'.

WEEK 3 **DATE: _____**

WHAT IS AN ELECTRO CHEMICAL CELL?

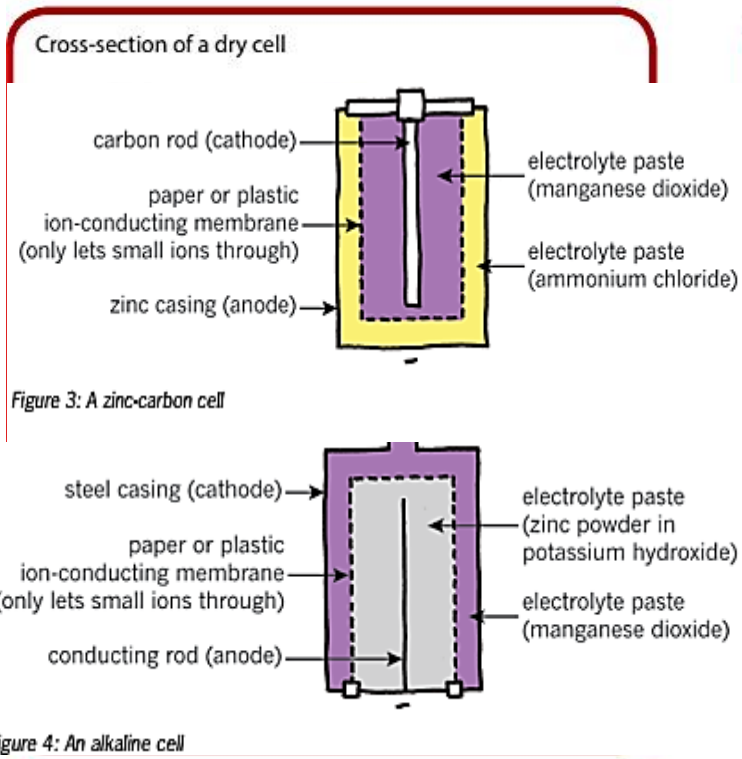
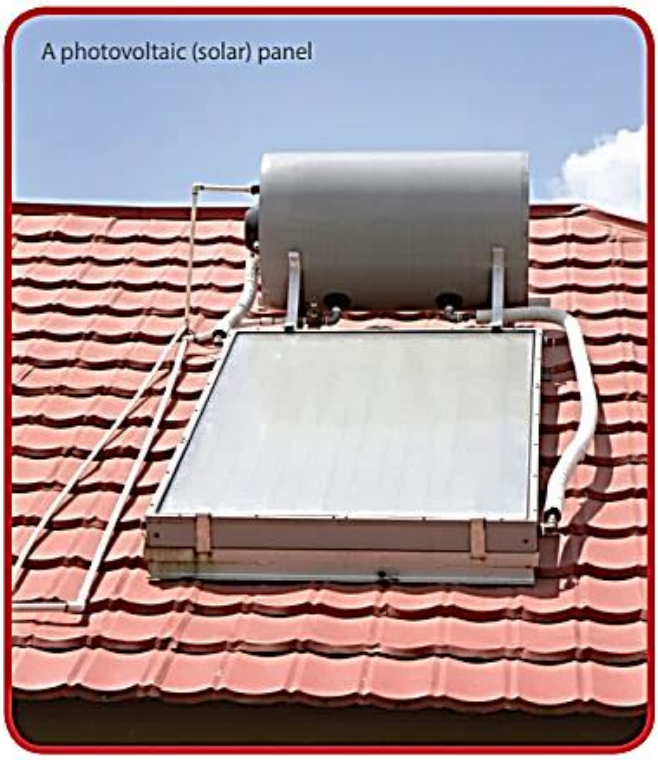
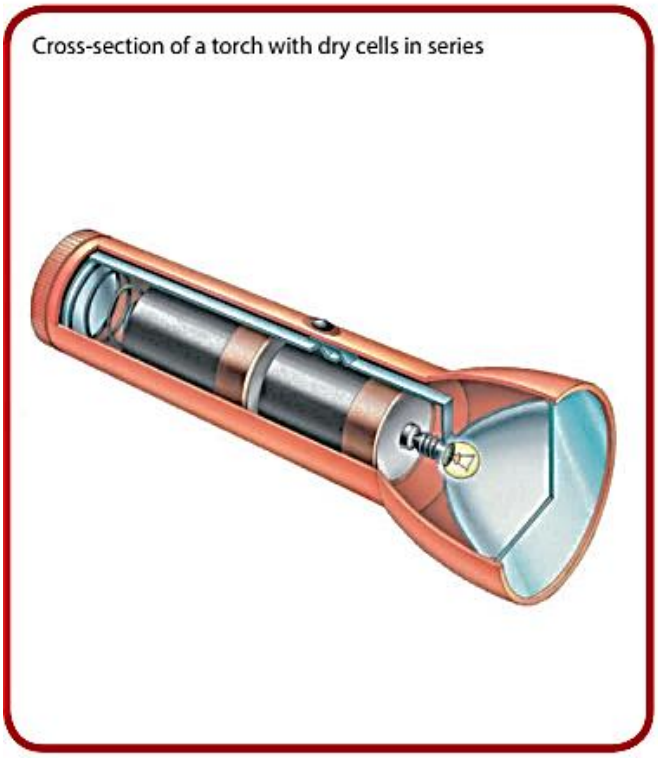


Figure 3: A zinc-carbon cell

Figure 4: An alkaline cell





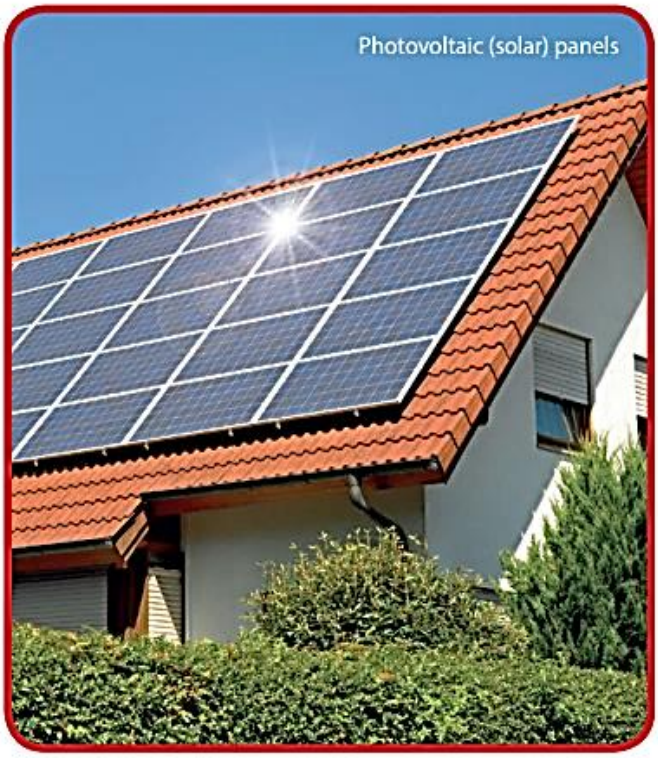


Figure 1 The cells we use

PHOTOVOLTAIC CELLS

Key word

- **photovoltaic cell** – a type of cell that converts the Sun's energy directly into electricity

Solar cells ***convert*** **the sun's energy directly into electricity**. Fifty years ago, the only solar cells in use were on satellites out in space. Today, they are used in every community around the world. You might even have a solar-powered calculator.

Satellite

Street sign

Calculator

Figure 11 How we use solar cells.

A **SOLAR CELL** is also known as a **photovoltaic cell** *('photo' means 'light' and 'voltaic' means 'electricity').*

The **active part** of a solar cell is made of the element **silicon**.

When **light energy falls on the solar panel, the light energy frees electrons in the silicon.**

Conductors attached to **opposite sides of the cell enable the electrons to flow around the circuit,** carrying the electrical energy (look at Figure 12).

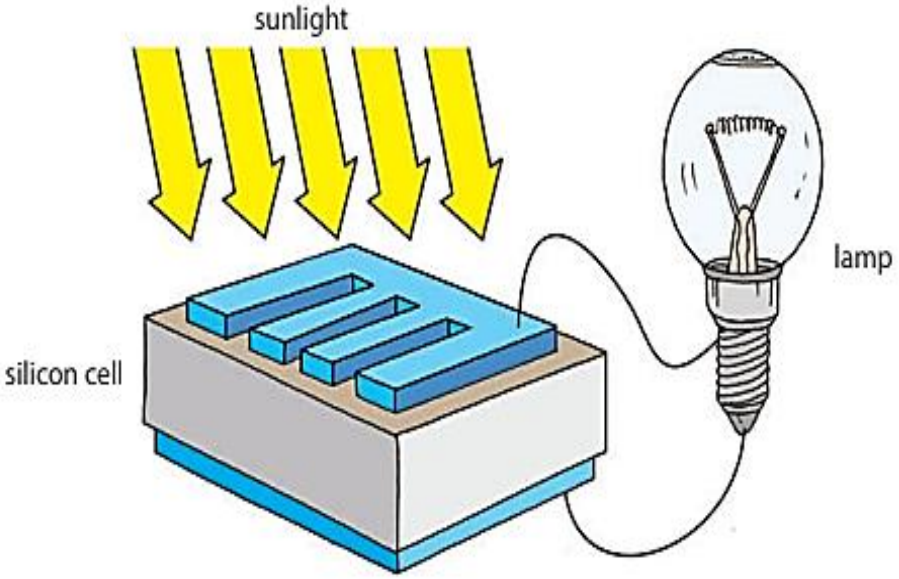


Figure 12 Light energy is converted into electrical energy in a photovoltaic cell.

ACTIVITY 6 DATE: _____

IMPACT OF /BIAS IN TECHNOLOGY: ENERGY MAKE THE DIFFERENCE

Read the Case study below and answer the questions that follows.

The Dramasi family live in a city which has grown too fast for the delivery of services. They have borrowed money to buy a solar powered lamp.The lamp uses solar cell that converts sunlight energy into electricity.The proper name for a solar cell is **photovoltaic cell.**

Advantages of photovoltaic cell is that the sun's energy is free; No negative effects on the environment.

Disadvantages are that **solar systems are expensiv**e and when **the sun does not shine,there is no solar energy.** Mr Dramasi moved into an informal settlement in a city from his village so that his wife could study nursing. In his village he was able to ask his family to collect wood for cooking their food and he spent a little money on paraffin for light at night so that his children could do their homework.

When the Dramasi's Moved to the city, they faced new challenges. There was no wood to collect so Mr Dramasi needed to buy paraffin for cooking as well as light. The smoke from the stoves in the nearby houses makes it difficult to keep their informal shelter clean. The smoke also causes health problems.

Mrs Dramasi saw a poster at nursing college for a solar powered light. During the day, it is left outside to charge. At night it can be used for about an hour and a half to allow Mrs Dramasi and her children to study.

6.1 Name possible challenges that the Dramasi family faced when living in the rural areas. (2)

6.2 Explain what challenges the Dramasi family faced when they moved into the city. (2)

6.3 List the environmental advantages that the solar powered light offers. (2)

6.4 Describe the economic advantages of the solar powered lamp. (1)

6.5 List the disadvantages of solar cells. (2)

ADVANTAGES AND DISADVANTAGES OF SOLAR CELLS

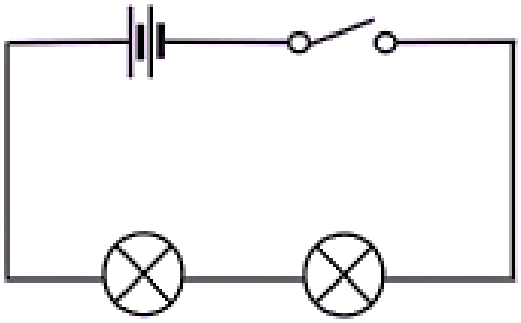
ADVANTAGES	DISADVANTAGES
1. The Sun's energy is free of charge 2. Solar energy is a renewable source 3. Solar cells do not have the same negative effects on the environment as conventional power sources do 4. Ongoing research will make solar cells more efficient and affordable in the near future. 5. Solar energy / Photovoltaic energy requires minimal maintenance cost 6. Solar energy reduces electricity bills 7. Solar energy causes no pollution. 8. Little maintenance is needed to keep solar cells running.	1. Solar panels can be expensive to install 2. when the Sun does not shine, there is no solar energy. 3. Solar energy storage is expensive 4. Solar energy is dependent on the weather

SERIES & PARALLEL CONNECTIONS

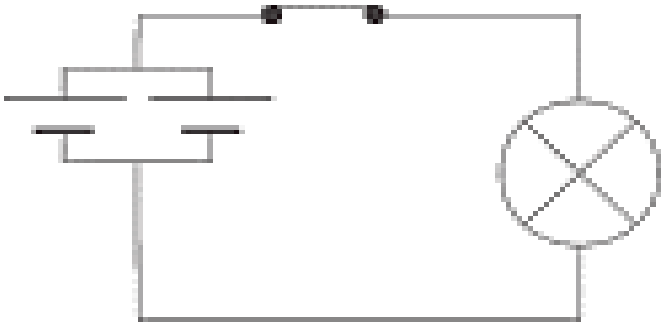
You have learnt about series and parallel circuits since grade 6. This is just to revise your knowledge on the mention circuit connections.

In series, the cells are in line; in parallel, they are next to each other. (Figure 8)

Two cells in series



Two cells in parallel

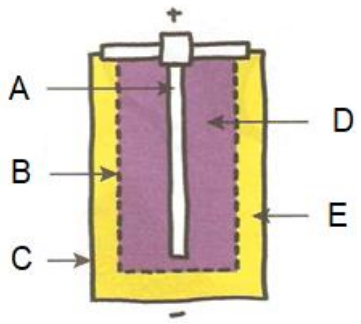


ADVANTAGES AND DISADVANTAGE OF BATTERIES IN SERIES AND IN PARALLEL

Battery type	Advantage	Disadvantage
Series	The lamp will shine brighter.	If there are too many cells in a battery, the components in a circuit can be damaged.
Parallel	The cells will last longer.	If the cells do not all have exactly the same voltage, current flows from one cell to the other, and energy is lost.

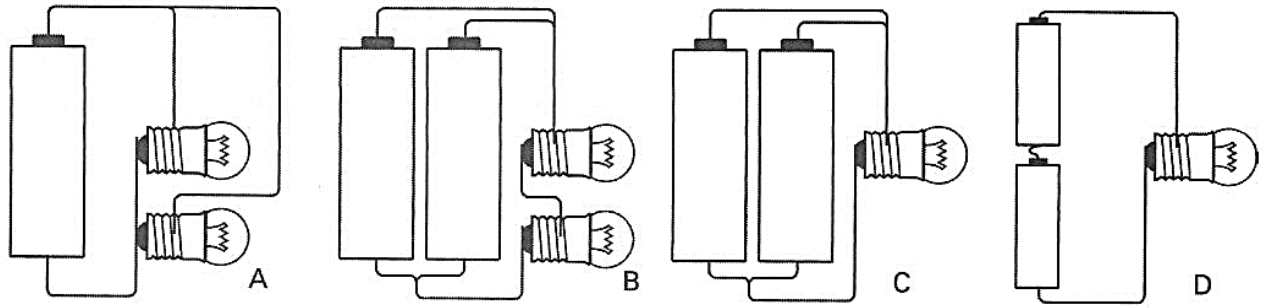
ACTIVITY 7 DATE: _____

7.1 Label the parts of the zinc-carbon cell labelled A – E by completing the table. (5)



A	
B	
C	
D	
E	

7.2 Study the circuit diagrams below and answer the questions that follow: (4)



In which of the four circuits drawn above are/will the:

7.2.1 light bulbs connected in series? _____

7.2.2 cells connected in series? _____

7.2.3 light bulbs connected in parallel? _____

7.2.4 light bulbs shine brightest? _____

7.3 Determine if the light bulb will '*de-energize'* OR have '*no effect'* for each of the following breaks in the circuit.

Consider just one break at a time: (5)

Choose one option for each point:

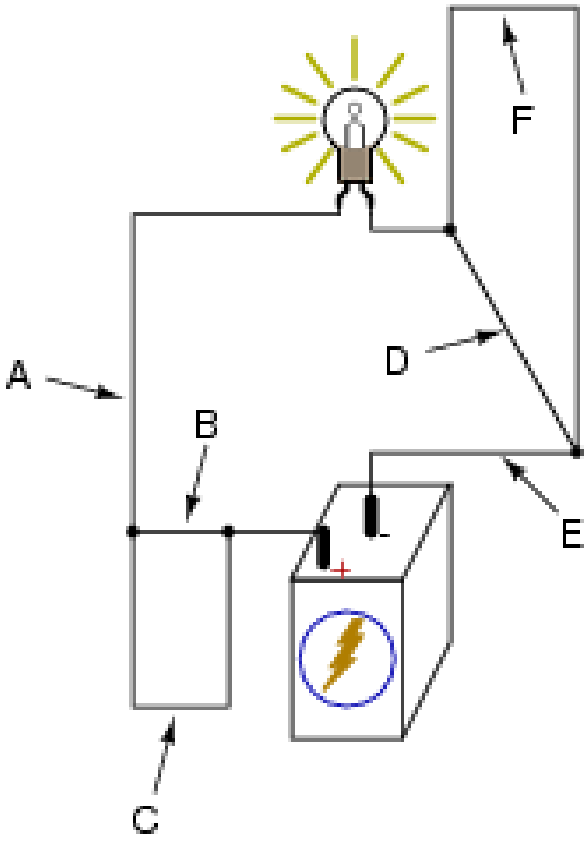
A: de-energize / no effect

B: de-energize / no effect

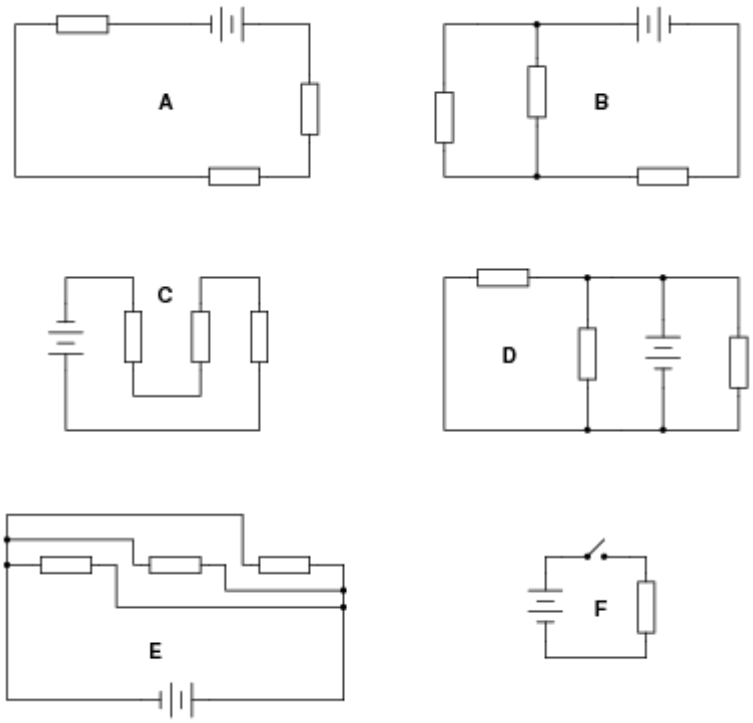
C: de-energize / no effect

D: de-energize / no effect

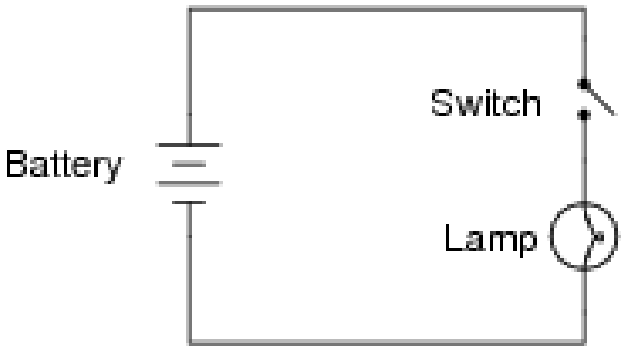
E: de-energize / no effect



7.4 Identify which of these circuits is a *parallel* circuit (there may be more than one): (2)
Encircle the parallel circuit/s



7.5 The following circuit has a problem. When the switch is closed, the lamp does not turn on:

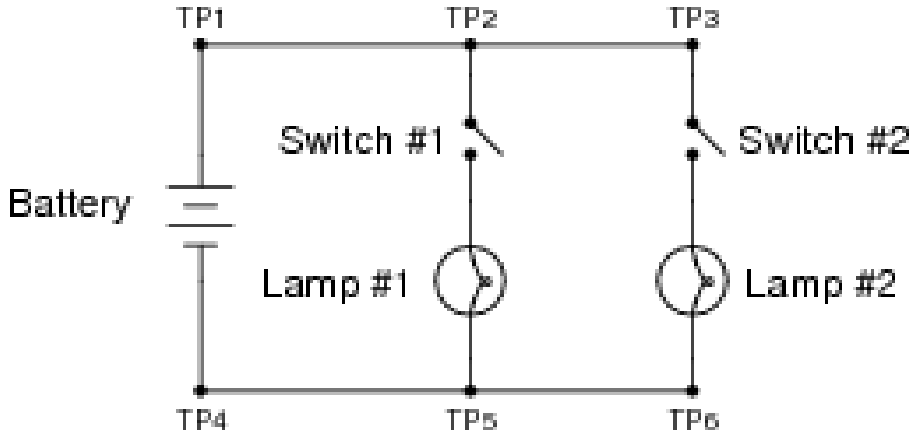


7.5.1 Predict which of these hypothetical faults could account for this problem, and which could not account for the problem. Indicate whether the probable fault could be the cause of the problem or could not account for the problem. (3)

Probable fault	**Possible cause of the problem**	**Could not account for the problem**
7.5.1.1 The light bulb is faulty		
7.5.1.2 The switch does not open		
7.5.1.3 A short in the circuit		

7.6 The following circuit has a problem. (5)

Switch #1 can control lamp #1, but lamp #2 never comes on no matter what is done with switch #2:

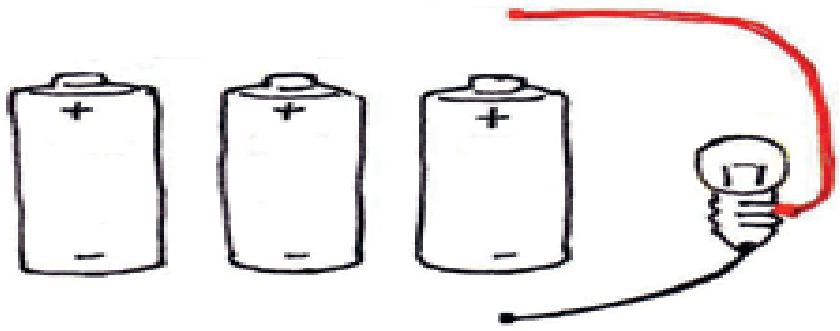


7.6.1 Predict which of these hypothetical faults could account for this problem, and which could not account for the problem.

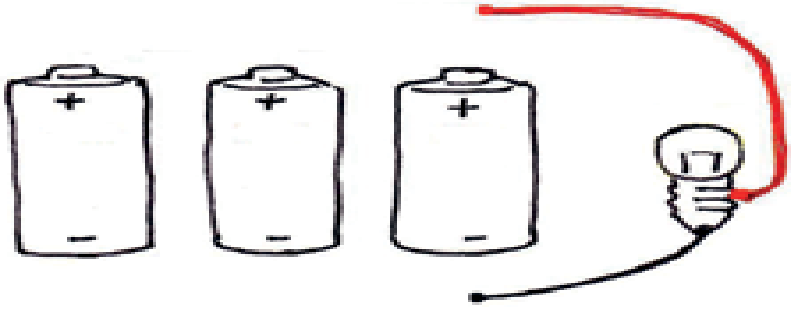
In other words, which of these faults are possible, and which are not possible, given the symptoms exhibited by the circuit? Consider each of these hypothetical faults one at a time.

Probable fault	***Possible* cause of the problem**	**Cannot account for the problem (*Not possible*)**
7.6.1.1 Battery is flat.		
7.6.1.2 Switch #2 failed to connect		
7.6.1.3 Switch #2 has a short circuit		
7.6.1.4 Bulb #1 is faulty		

7.7 Draw wires between terminals of these cells to show how you would connect them in **series**. (3)



7.8 Draw wires between terminals of these cells to show how you would connect them in **parallel**. (3)



7.9 Write at least TWO advantages and TWO disadvantages of the following. (8)

	ADVANTAGES	**DISADVANTAGES**
SERIES connection	…… …… …… …… …… …… …… …… …… …… …… …… …… …… ……	…… …… …… …… …… …… …… …… …… …… …… …… …… …… ……
PARALLEL connection	…… …… …… …… …… …… …… …… …… …… …… …… …… …… ……	…… …… …… …… …… …… …… …… …… …… …… …… …… …… ……

WEEK: 4 GENERATION OF ELECTRICITY

Electricity generation is the process of creating electricity (secondary energy source) from other forms of energy (primary sources). Electrical energy in South Africa is generated at power stations by Eskom.

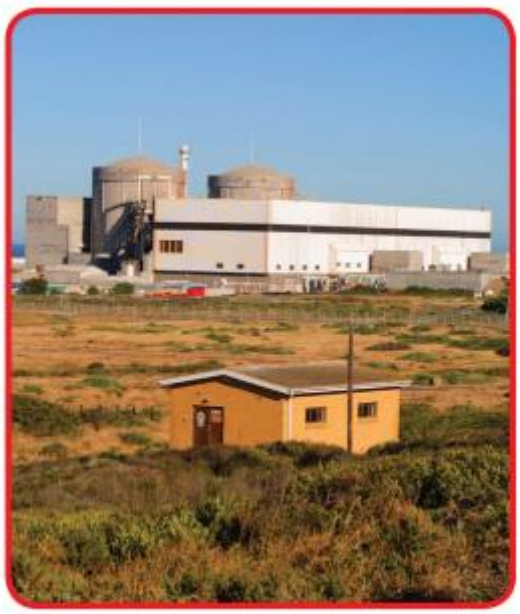


Figure 3 A nuclear power station

SOURCES OF ELECTRICITY IN SA

A. SOLAR ENERGY
B. WIND
C. COAL
D. NUCLEAR
E. HYDRO / WATER ENERGY

A. SOLAR ENERGY – solar cells convert light energy from the sun into electric energy.

B. WIND movement – powers generators.

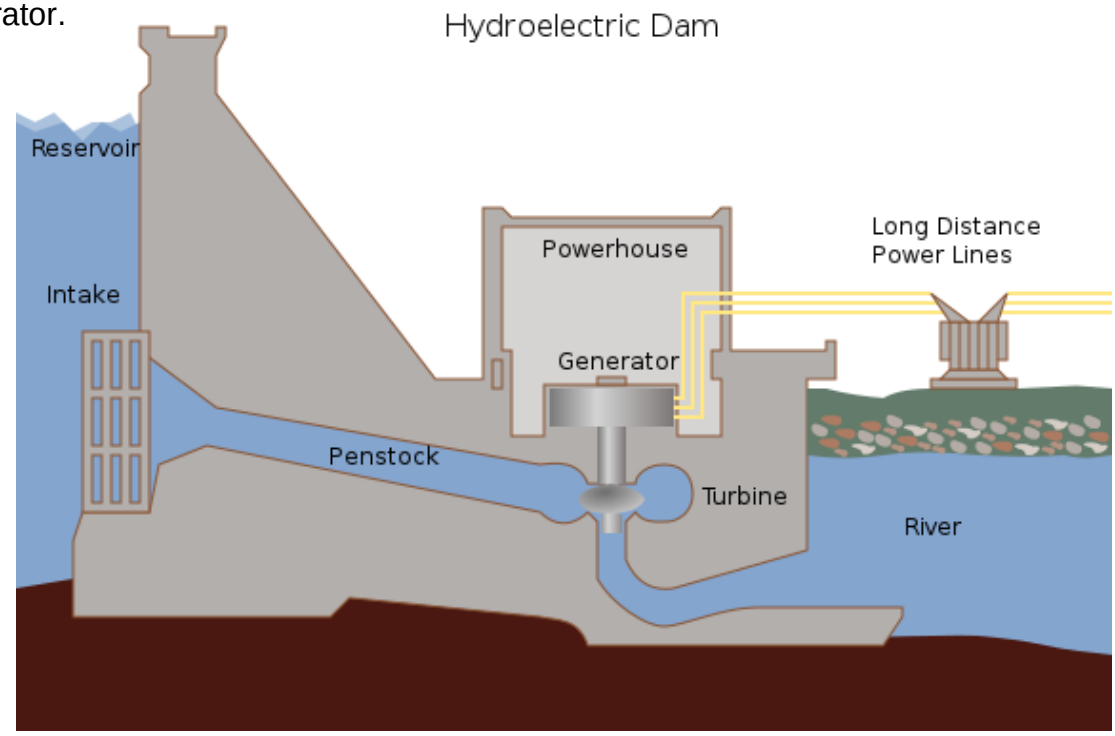
Wind can be used to do work. The kinetic energy of the wind can be changed into other forms of energy, either mechanical energy or electrical energy.

Blowing wind spins the blades on a wind turbine -- just like a large toy pinwheel. This device is called a wind turbine and not a windmill.

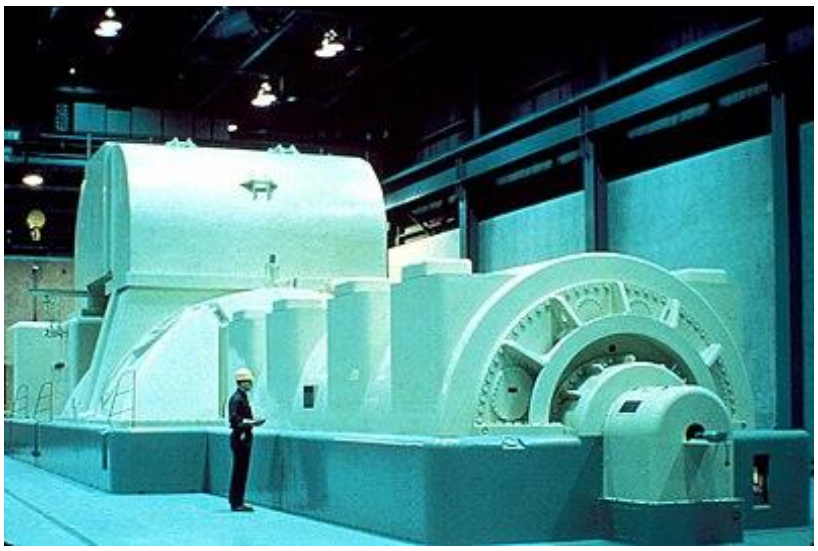
C. COAL ENERGY – this is the energy released because **of burning coal - steam driving a turbine connected to a generator.**

D. NUCLEAR ENERGY – this is the energy **released because of nuclear fusion** – resulting in **kinetic energy** – **steam driving a turbine connected to a generator.**

E. HYDRO-ELECTRICITY – fast falling **water** from a dam, turns a turbine, the turbine turns a generator.



An ELECTRICAL GENERATOR is a device that converts mechanical energy to electrical energy. Generators are **turned by machines called turbines**, which spin at high speed. The **turbines are driven by steam, by fast-flowing water or by wind.**



Most of our electrical energy comes from steam powered generators. The steam comes from boilers (which are like kettles), most of which are heated by burning coal. At **Koeberg in the Western Cape**, the boilers are heated by **nuclear power**.

ADVANTAGES AND DISADVANTAGES OF DIFFERENT ENERGY SOURCES

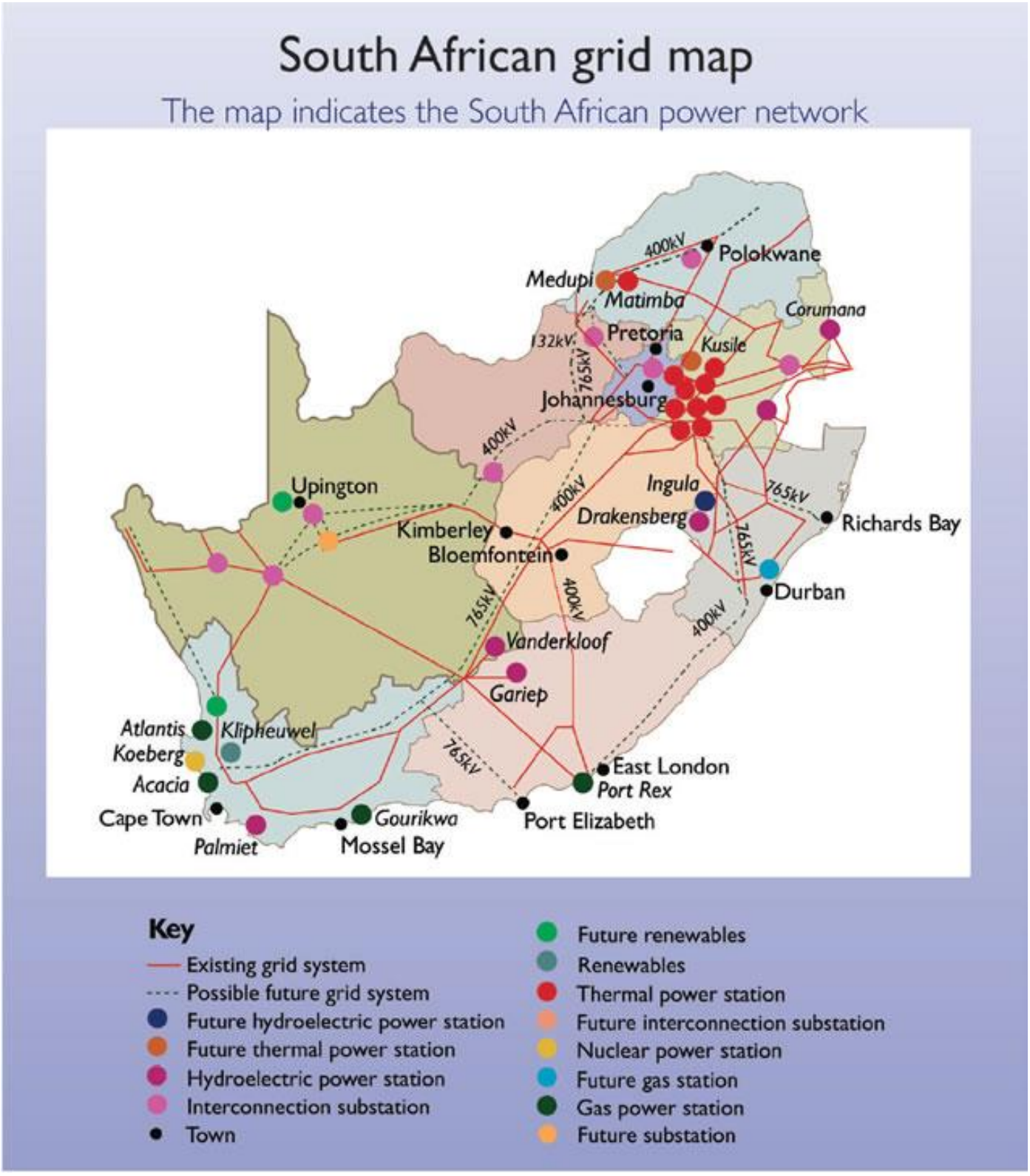
Table 1 Advantages and disadvantages of energy sources in South Africa

ENERGY SOURCE	ADVANTAGES	DISADVANTAGES
COAL (THERMAL)	• South Africa has a **lot of cheap coal.**	• Burning coal causes **air pollution**. • Coal is **non-renewable**, so it will eventually run out.
GAS (THERMAL)	• Gas **creates less pollution than coal**.	• We have limited **sources of natural gas**.
NUCLEAR (THERMAL)	• We have **enough nuclear fuel** to last for hundreds of years.	• People and the en**vironment are endangered by accidents that can occur when power is generated**. • They can also be **harmed by incorrectly stored used fuel**.
SUN (THERMAL)	• The Sun's energy **is free** of charge • Solar energy is a **renewable source** • Solar cells do **not have the same negative effects on the environment as conventional power sources.** • Ongoing research will make solar cells **more efficient and affordable in the near future.** • Solar energy / Photovoltaic energy **requires minimal maintenance cost** • Solar energy **reduces electricity bills** • Solar energy causes **no pollution**. • **Little maintenance** is needed to keep solar cells running.	• • Solar panels can be expensive to install • when the Sun does not shine, there is no solar energy. • Solar energy storage is expensive • Solar energy is dependent on the weather
HYDRO-ELECTRIC	• There is **no pollution**. • The water can be used for other purposes.	• Our country does not have a lot of water. • Dams in South Africa slowly filling up with silt carried by the water. Over time, the dams become useless.
WIND	• There is **no pollution**. • Wind energy is **free**.	• Electricity **cannot be generated when there is no wind**. • Wind turbines can be **ugly and noisy**

[Platinum, Grade 8 – page 182]

DISTRIBUTION OF ELECTRICITY IN SA

Eskom's power grid



REF: http://financialresults.co.za/2012/eskom_ar2012/integrated-report/sa-grid-map.php

NATIONAL POWER GRID

Electricity produced at power stations needs to be delivered to users **cheaply and safely**. It is **delivered to us** by **cable**, and it passes through **substations and transformers** along the way.

The electricity in your home comes from power stations far away. It is distributed **via the national grid**, which is a network of substations and power lines that covers the country. **The power lines are thick aluminum or copper cables that are supported high above the ground by pylons**. At substations, which are also called distribution stations, electricity from **large power lines is distributed to smaller power lines.**

DIRECT CURRENT & ALTERNATING CURRENT

A. DIRECT CURRENT (DC): It is called direct because the ***current flows in one direction only*****.**

- DC is used by **devices that operate at a low voltage** or that have a **low power requirement**, such as **cell phones, laptop computers**.
- DC can be **saved and stored in batteries**. AC cannot be saved.

B. ALTERNATING CURRENT (AC): The **direction of alternating current changes constantly**.

- The electricity we use in **homes, offices and schools** is **alternating current (AC)** because it is **easier to generate and cheaper to distribute** than DC
- AC is used for devices and machines that **operate at a high voltage** or that require a lot of power.

STEP-UP AND STEP-DOWN TRANSFORMERS

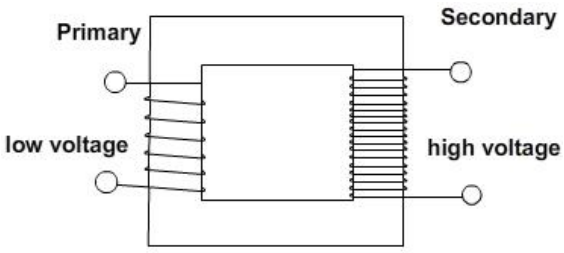
https://vietnamtransformer.com/our-news/difference-between-step-up-and-step-down-transformer

A **transformer** is a device that **converts high-voltage electricity to low-voltage electricity (and low-voltage electricity to high-voltage electricity).** The same transformer can be used as a step-up transformer or step-down transformer. It depends on how it is connected in the circuit.

If the **input supply** is supplied on the **low-voltage winding**, it becomes a **step-up transformer**. On the other hand, if the input power is supplied on the **high voltage winding**, the transformer becomes a **step-down transformer.**

STEP-UP TRANSFORMER

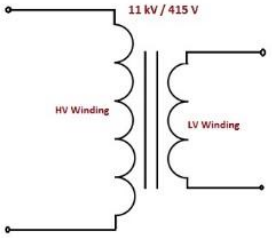
The step-up transformer is converting **low voltage** (LV) and high current from the transformer's primary side **to high voltage** (HV) and low current value on the transformers' secondary side.



STEP UP transformer
Output voltage GREATER THAN input voltage

STEP-DOWN TRANSFORMER

The step-down transformer is a type of transformer that converts **high voltage** (HV) and low current from the primary side of the transformer **to low voltage** (LV) and high current value on the secondary side of the transformer.



THE MAJOR DIFFERENCE BETWEEN A STEP-UP TRANSFORMER AND A STEP-DOWN TRANSFORMER

When the output (secondary) voltage is greater than the input (primary) voltage, it is called a step-up transformer. In comparison, the output (secondary) voltage of the step-down transformer is smaller.

ACTIVITY 8 DATE: _____

8.1 Name three renewable ways in which electricity can be generated. (3)

8.2 What is the national electrical energy grid? (3)

8.3 What is the function of a transformer? (1)

8.4 What are the positive effects of making electricity from fossil fuels? (2)

8.5 In what way does making electricity from fossil fuels damage the environment? (4)

8.6 Identify the problems caused to people's health by making electricity from fossil fuels. (2)

8.7 Suggest TWO ideas for what can be done to solve these health and environmental problem (2)

8.8 Write the positive and negative aspects of using each of the following to generate electricity.

8.8.1 Solar power generation (10)

POSITIVE	**NEGATIVE**

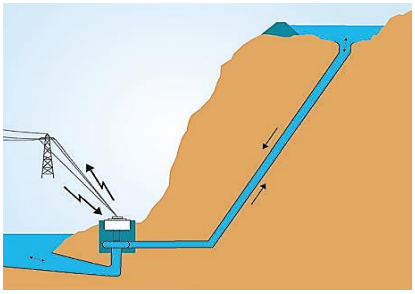
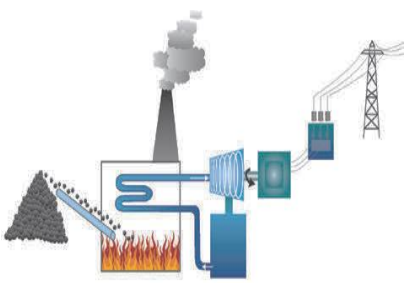
8.8.2 Hydroelectric – power generation. (10)

POSITIVE	**NEGATIVE**

8.8.3 Wind turbines – power generation. (10)

POSITIVE	**NEGATIVE**

8.9 Identify the source of energy and the advantages and disadvantages of each. (15)

		Source of energy	**Advantages**	**Disadvantages**
A				
B				

		Source of energy	Advantages	Disadvantages
C				
D				
E				

8.10 Match the correct statement with the correct term by writing the letters in the answers column. (4)

Term	Answers	Statements
7.1 Step-up transformer		A. Electric charge moves back and forth transfering energy through the circuit.
7.2 Step-down transformer		B. In a circiut that uses cells and batteries, electric charge moves in one dirrection .
7.3 Alternating current		C. It is used to reduce the energy from mains power supply.
7.4 Direct current		D. It is used at power stations to produce very high voltages.

8.11 Draw and label a step-up transformer. (5)

8.12 What is the function of a transformer? (1)

_____

_____

WEEK 5: CIRCUITS WITH RESISTORS (BULBS) CONNECTED IN SERIES

RESISTORS IN SERIE

- In a circuit with **equal resistors in series**, the **greater the number of resistors, the smaller the current in the circuit will be.**

- In a **series circuit, the current flows through each component** and never changes.

- If **several light bulbs** (or any other electrical components) are **connected in a circuit** so that the electric current flows first through the one and then through the next, they are connected in series.

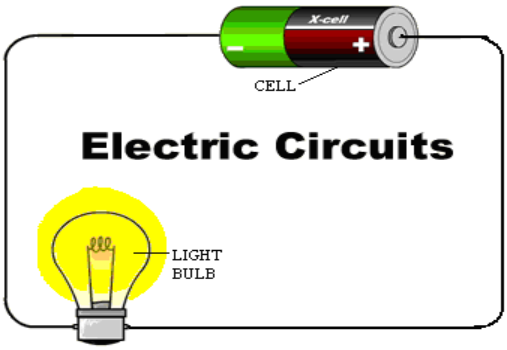
DEMONSTRATION BY THE TEACHER / GROUP WORK

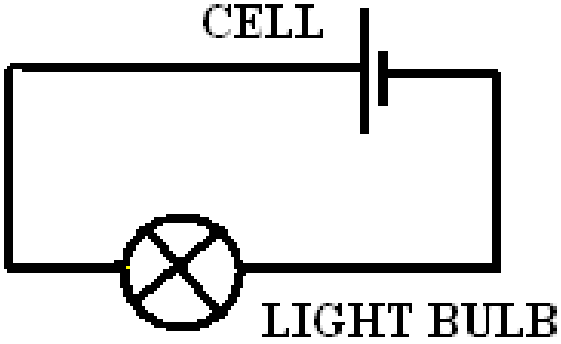
The more the light bulbs in series, the greater resistance.

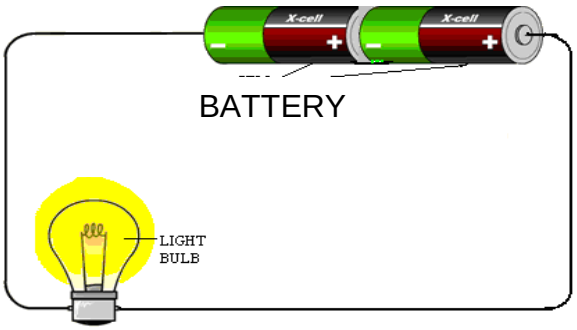
1. Connect the two circuits as shown below and note the brightness of the 3V light bulb with one cell and then with two cells in series.

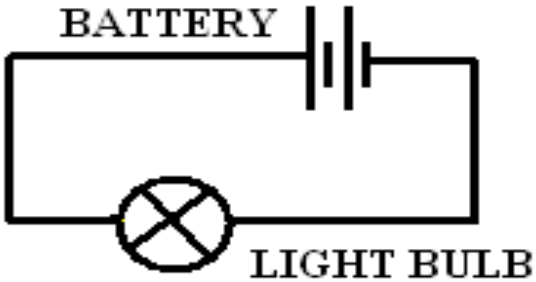
2. Write your conclusions down and discuss them in groups.

Note: each cell is 1, 5V.and the light bulb must be 3V



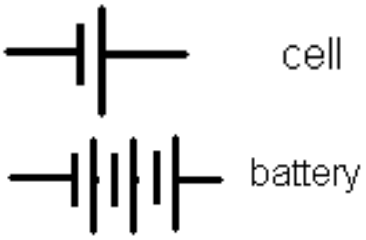






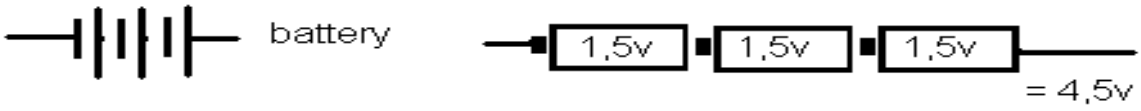
➔ Why do we use a 3V light bulb in this activity?

CELLS AND BATTERIES IN SERIES



A battery is two or more cells connected in series to one another.

When cells are connected in series, the potential differences (voltage) add up**: 1.5 V + 1.5 V + 1.5 V= 4.5 V**



REMEMBER THE CURRENT (I) ALWAYS STAYS THE SAME IN A SERIES CIRCUIT.

FORMULA FOR THE CURRENT IN A SERIES CIRCUIT WILL BE:

$$I_T = I_1 = I_2 = I_3$$

- **Each light bulb** offers a **certain amount of resistance** to **electricity flowing through it** and the **total resistance is the sum of the resistance** of all the light bulbs.

- If **more light bulbs were inserted** in the circuit the **resistance to the flow of electricity would be increased.**

The total resistance of a series circuit will be the sum of all the resistance in the circuit.

$$R_T = R_1 + R_2 + R_3$$

The **electrical voltage** in a circuit will **stay constant** as per the supply voltage but there will be a volt drop across each light bulb or resistance.

Therefore, the **total or sum of all the volt drops across light bulbs or resistances will be equal to the applied voltage.**

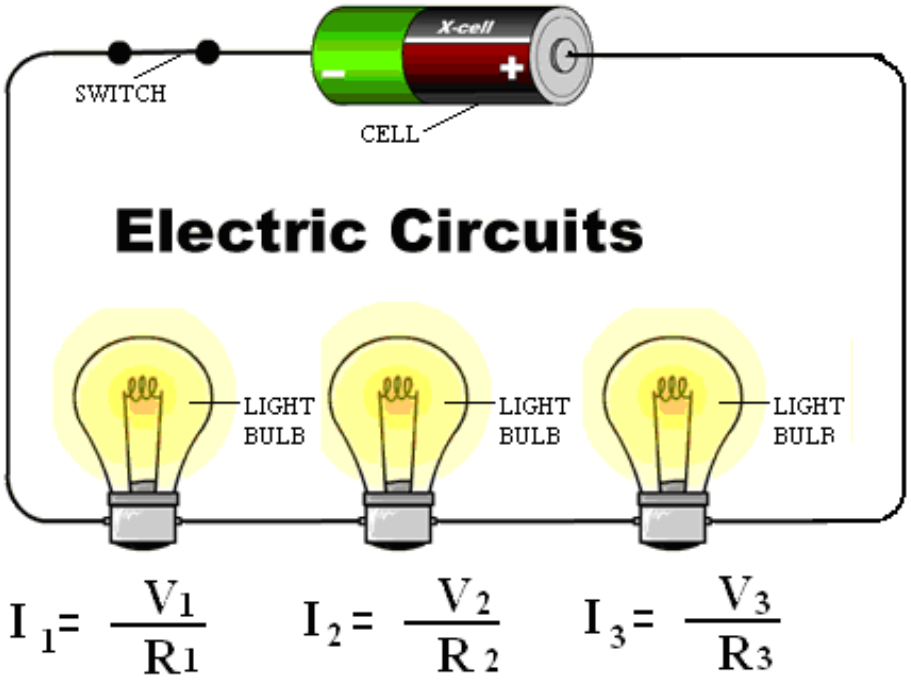
$$V_T = V_1 + V_2 + V_3$$

Ohm's Law can therefore be applied across every light bulb or resistance in a series circuit.

- **If one light bulb (component) burns out or gets defective in any way the rest of the light bulbs (components) will not burn**. The current will be interrupted.

CONCLUSION

Therefore, we can conclude that the greater the resistance in the circuit, the lesser the current and the dimmer the lights

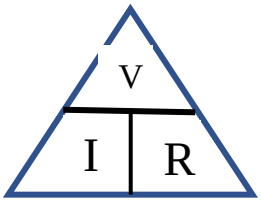


$$I_1 = \frac{V_1}{R_1} \qquad I_2 = \frac{V_2}{R_2} \qquad I_3 = \frac{V_3}{R_3}$$

There is a **relationship** between the *electrical pressure (V)* that makes a current (I) flow, the *rate at which the electricity flows* (current strength) and the *resistance (R) of the light bulbs* through which the current passes.

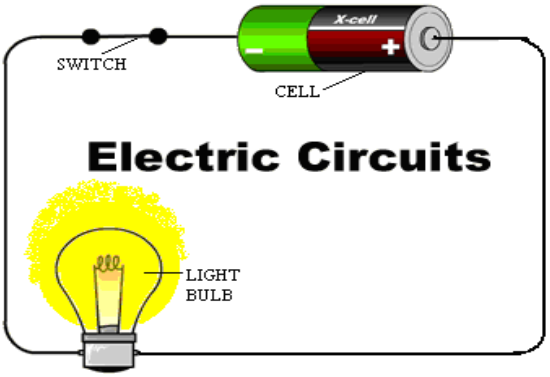
- **Remember that the current stays the same in the series circuit.**
- **If there is *only one light bulb* in the circuit the *resistance will be small*.**
- **The applied voltage will be across the light bulb.**

BULB WILL SHINE BRIGHT



V = I x R

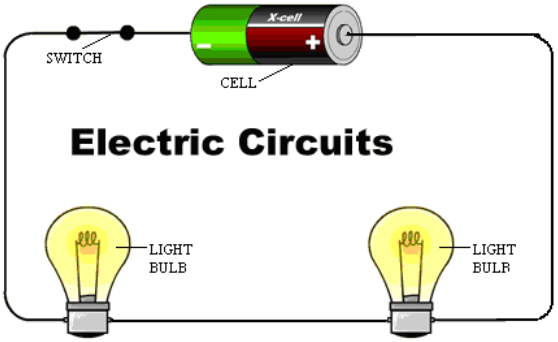
The light bulb will burn very brightly because the current flowing through the light bulb is high.



2 BULBS → LESS BRIGHT

With **two light bulbs** in the circuit, **the current will decrease** in the circuit because the *resistance has increased.*

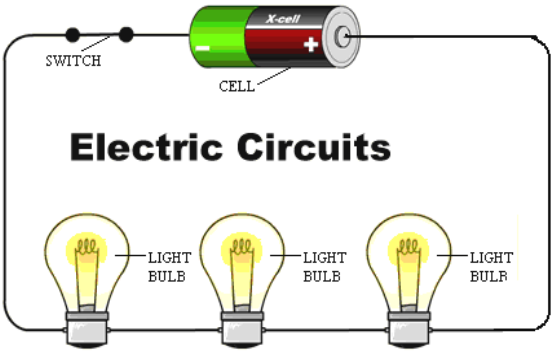
If R = 20Ω and the voltage is still 1.5V the current (I) = 0.075A in the circuit. This will have an influence on the brightness of the two light bulbs. They will not burn very bright.



3 BULBS → VERY DIM

With **three light bulbs in the circuit** the current will ***decrease even more*** and that will result in the three light bulbs **burn even less brightly.**

If R = 30Ω and the voltage is still 1.5V the current (I) = 0.005A in the circuit. This will have a bigger influence on the brightness of the three light bulbs. They will not burn bright at all.



CONCLUSION:

- The ***more the light bulbs*** **in series**, the ***greater resistance.***
- Therefore, we can conclude that the ***greater the resistance*** **in the circuit, the *lesser the current and the dimmer the lights***

PARALLEL CIRCUIT

If several light bulbs or any other electric component are connected to a battery in such a way that the ***current can flow through each light bulb (component) via a separate route***, they are said to be connected in ***parallel***.

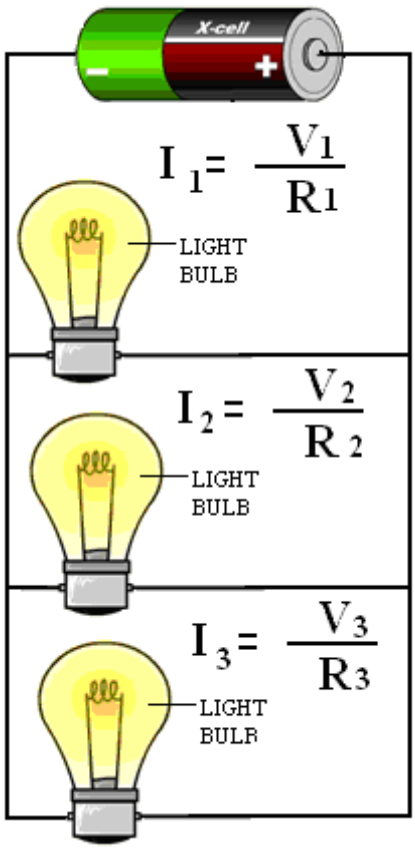
When the circuit is switched on the current flows directly from the battery and through each light bulb (component) separately.

- **All the light bulbs will glow with the same brightness.**
- If **one light bulb (component) burns out** or gets defective in any way **the rest of the light bulbs (components) will remain glowing.**
- In a parallel circuit, the **current divides according to the proportion of the resistance** of each branch.
- The **greater the resistance the less the current will flow through that part of the circuit.**
- The **current will divide** and therefore the *formula for the current in a parallel* circuit will be the **sum of all the currents flowing through each light bulb or resistor**.

$$I_T = I_1 + I_2 + I_3$$

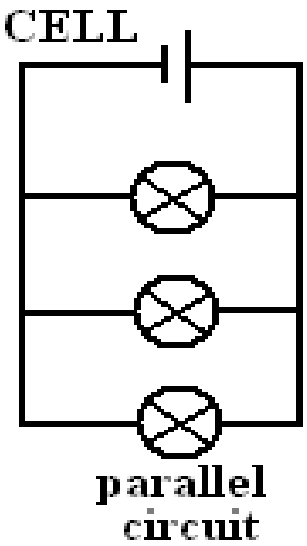
Each light bulb offers a certain amount of **resistance to current** flowing through it and **the total resistance of a parallel circuit will be the inverse of the inverse sum of the resistance of each separate light bulb**. The total resistance in a parallel circuit will therefore be formulated as:

$$Re = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$$



The voltage in a parallel circuit will stay the same across each of the light bulbs or resistances.

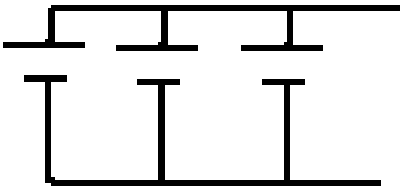
$$V_T = V_1 = V_2 = V_3$$

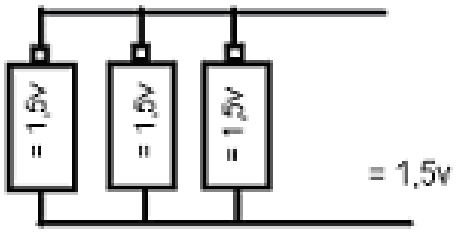


- **Remember that $V_T = V_1 = V_2 = V_3$. That means that the light bulbs will always burn the same brightness if they are the same voltage.**

CELLS IN PARALLEL

When cells are connected in parallel, the potential differences or voltage across each cell remains the same ($V_T = V_1 = V_2 = V_3$).





OHM'S LAW

Ohm's Law says: If the resistance of a conductor does not change, the current that flows through the conductor is proportional to the voltage.

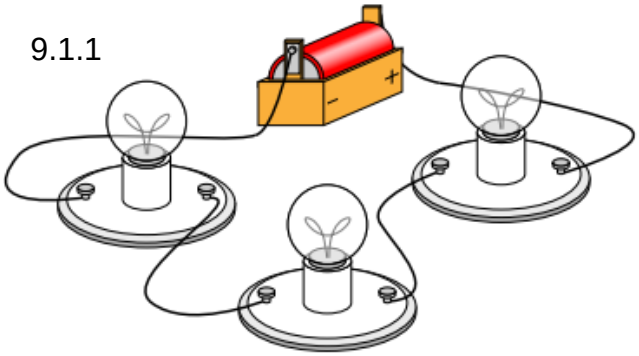
To find out what Ohm's Law means we analyse it phrase by phrase in the table below:

Phrase in Ohm's Law	What the phrase means	A question	The answer
If the resistance of a conductor does not change …	This tells us that we need a conductor with a resistance that does not change.	Do we have a conductor with a resistance that does not change?	Yes, the resistance of a lamp does not change.
… the current … is proportional to the voltage.	Another way of saying this is: the bigger the voltage the bigger the current. This means that we need to be able to increase the voltage.	How can we increase the voltage?	Increase voltage by adding cells in series.
… the current that flows through the conductor …	This tells us that we are interested in the amount of current that flows through the conductor.	How can we know about the amount of current following through the conductor?	If a lamp is used as the conductor, it will shine more brightly when the current increases.

ACTIVITY 9 DATE: _____

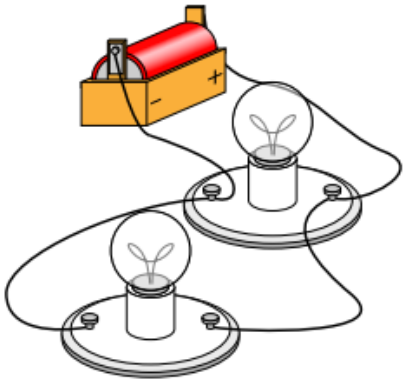
9.1 Identify the following circuits

9.1.1



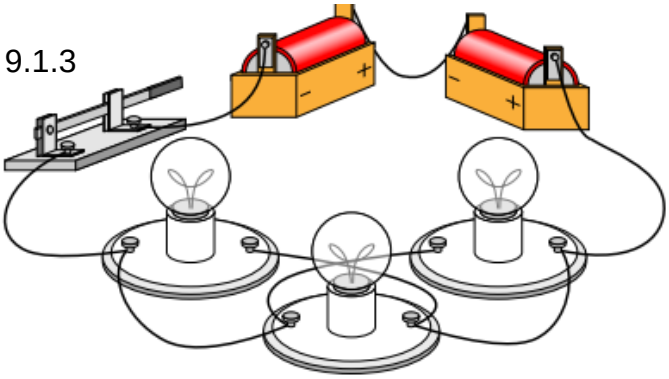
type: _____

9.1.2



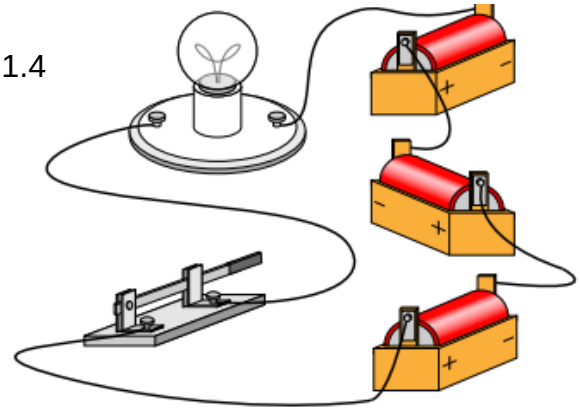
type: _____

9.1.3



Type: _____

9.1.4



Type: _____

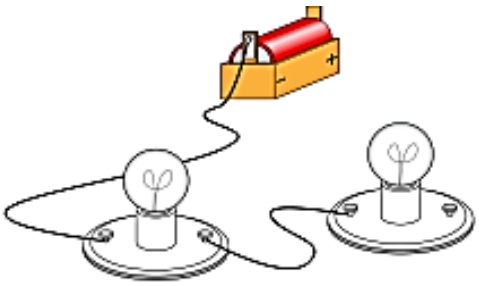
9.2 Explain why the light bulb wont light in the circuit on the right.

_____

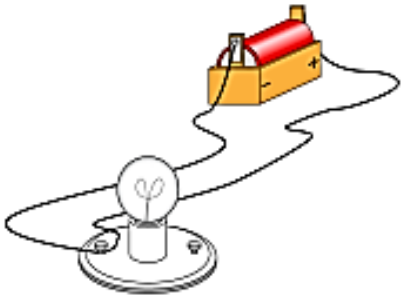
_____

_____

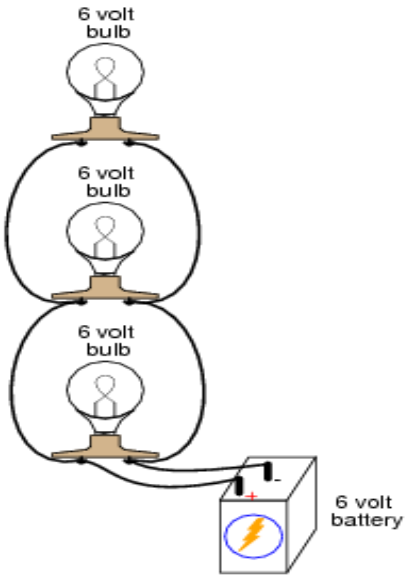
_____



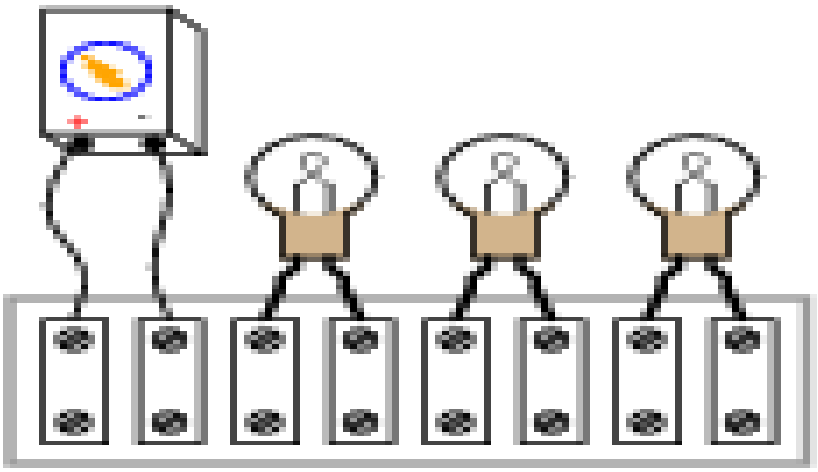
9.3 Explain why the light bult is not lighting up in the circuit on the right.



9.4 Qualitatively compare the voltage and current for each of the three light bulbs in this circuit (assume the three light bulbs are identical):



9.5 Draw the connecting wires on this terminal strip so that the three light bulbs are wired in parallel with each other and with the battery.



WEEK 6: LOGIC GATES AND TRUTH TABLES

"AND" and "OR" gates

We all use electronic equipment such as computers, watches, cell phones, and so on. Our world depends on the electronic circuits in these devices.

What are logic gates?

- A logic gate is a small computer circuit that simulates a logic operation.
- There are one or two wires that go into the gate that represent the input.
- There is one output wire that represents the result of the logic operation.

What is a logic operation?

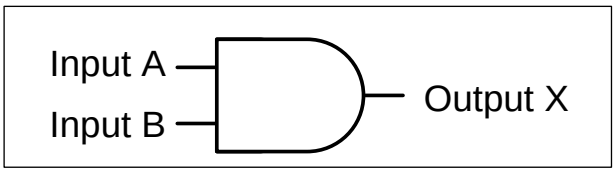
- A logic operation is the decision the small computer circuit makes. This depends on the inputs the logic gates receive and what type of logic gate it is.

What type of logic gates do you get?

You get AND; OR; NOT; NAND, NOR and other gates, but we are only going to look at the AND; and OR gates.

What does "AND" GATE mean?

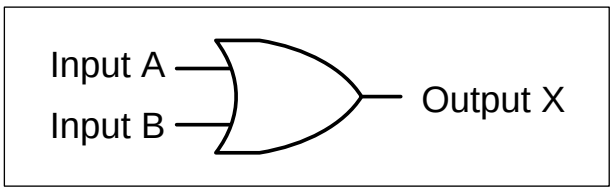
- When we say "AND," formally we mean that something is true only when both conditions for that something are true.



- If the stove is on AND there is water in the kettle, then we can boil the water to make tea.
- If either part is not there, then the result will not be true.

What does "OR" GATE mean?

- When we say "OR," formally we mean that something is true when any one of the conditions is true.
- If you open your curtains in the day OR you switch on your light, then your room will be bright.



TRUTH TABLES for AND and OR logic conditions

In response to a pair of 'on' and 'off' input signals, a logic gate gives an outputsignal which is either 'on' or 'off.'

On many household switches, a 'one' marks the on position and a '0' marks the offposition (look at Figure 16).

Regarding logic gates we say:

a signal has 'truth value of 1' when it is on
a signal has 'truth value of 0' when it is off.

A table of truth values for all the signals in a gate is called a truth table.

The truth table for an AND gate is shown below.

Truth table for an AND gate			
Signals:	**Input signal A**	**Input signal B**	**OUTPUT signal C**
Logic values	0	0	0
	0	1	0
	1	0	0
	1	1	1

REMEMBER:

- **If both the inputs are off, the output is off.**
- **If one of the inputs is off, the output is off.**
- **The output of an AND gate is on when both the inputs are on.**
- **The truth table for an OR gate is shown below.**

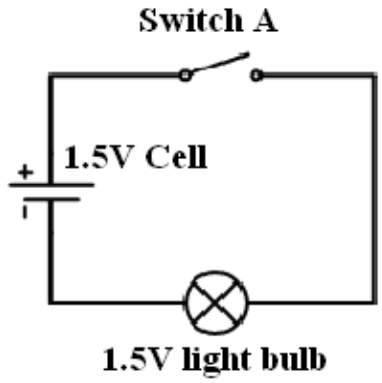
Truth table for an OR gate			
Signals:	**Input signal A**	**Input signal B**	**OUTPUT signal C**
Logic values	0	0	0
	0	1	1
	1	0	1
	1	1	1

REMEMBER:

- If both the inputs are off, the output is off.
- The output of an OR gate is on when either one or both the inputs are on.

PREDICT WHAT WILL HAPPEN IN THE FOLLOWING LOGIC CIRCUITS.

CIRCUIT 1



1. What happens when you close the switch? _____
2. What happens when you open the switch again? _____

In this circuit, the switch is the **input** because it determines what happens to the light. The light is the **output**.

We can now write the systems inputs "mathematically." We can say that if the switch is **open, we write a "0"** and if the switch is **closed, we write a "1"**

Just like below:

Input (Switch A)	**Output (Light)**
1 (closed switch)	
0 (open switch)	

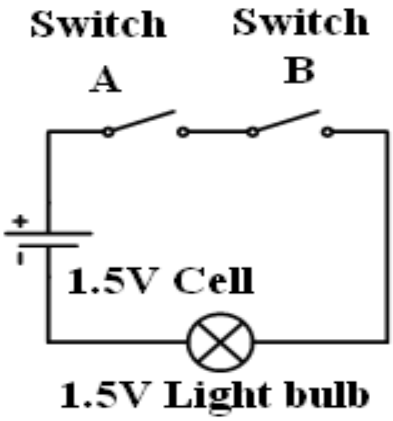
We can also write the output like this. We can write a "1" when the light is on and a "0" when the light is off.

By using this information, complete the output of the table.

Therefore, what is a basic logic circuit?

- If the input to the gate is a 1 the output will also be a 1 (If you say it is "true" – it will be true)
- If the input to the gate is a 0 the output will also be a 0 (if you say it is "not true" then it will be not true)

CIRCUIT 2



3. What happens to the light bulb when switch A and switch B are both open?

_____

4. What happens to the light bulb when switch A is open and switch B is closed?

_____

5. What happens to the light bulb when switch A is closed, and switch B is open?

_____

6. What happens to the light bulb when switch A and switch B are both closed?

_____

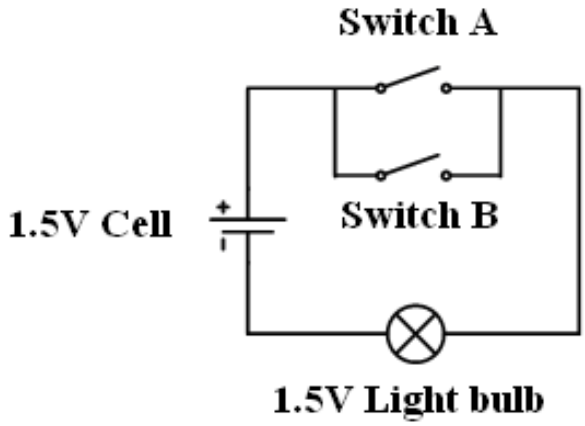
Just like with the basic logic circuit, complete the logic table for each of the scenarios described in the above questions:

Input (Switch A)	Input (Switch B)	Output (Light)
0	0	
0	1	
1	0	
1	1	

Therefore, what is an "AND" function:

- If the input to the gate is a 0 and a 0 it will give a _____ as an output
- If the input to the gate is a 0 and a 1 it will give a _____ as an output
- If the input to the gate is a 1 and a 0 it will give a _____ as an output
- If the input to the gate is a 1 and a 1 it will give a _____ as an output

CIRCUIT 3



7. What happens to the light bulb when switch A and switch B are both open?

_____

8. What happens to the light bulb when switch A is open and switch B is closed?

_____

9. What happens to the light bulb when switch A is closed, and switch B is open?

_____

10. What happens to the light bulb when switch A and switch B are both closed?

_____

Just like before, complete the logic table for each of the scenarios described in the above questions:

Input (Switch A)	Input (Switch B)	Output (Light)
0	0	
0	1	
1	0	
1	1	

Therefore, what is an "OR" function:

- If the input to the gate is 0 or a 0 it will give a _____ as an output
- If the input to the gate is 0 or a 1 it will give a _____ as an output
- If the input to the gate is 1 or a 0 it will give a _____ as an output
- If the input to the gate is 1 or a 1 it will give a _____ as an output

ACTIVITY 10 DATE: _____

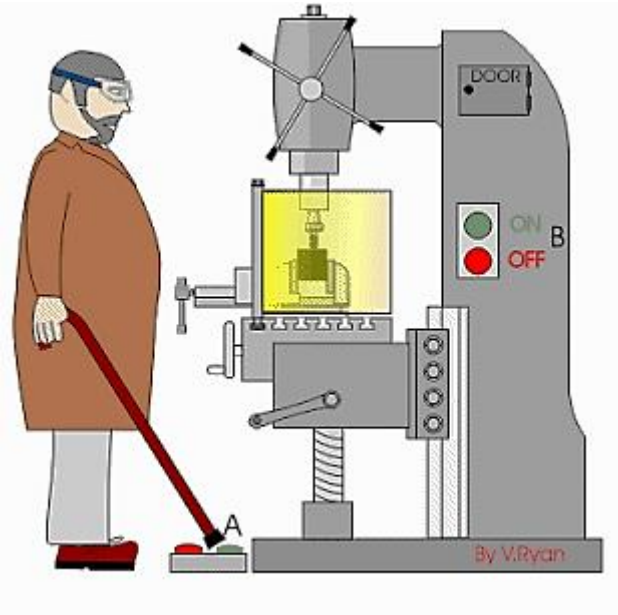
10.1 Describe in your own words what a logic gate is:

10.2 Give an example of an “AND” operation:

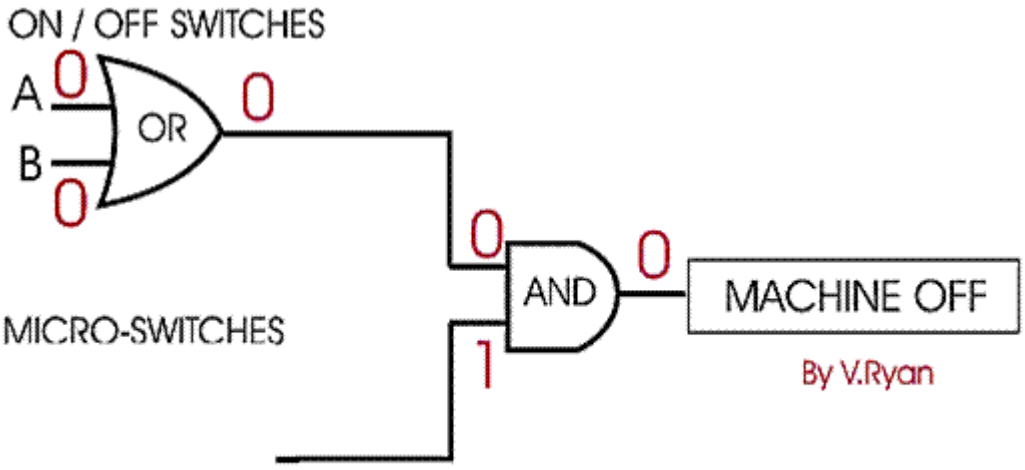
10.3 Give an example of an “OR” operation:

10.4 A metal cutting milling machine has two switches, ***anyone*** will allow the cutter to run.

The first switch is on the side of the machine and the second is a foot operated switch. However, the machine has two micro-switches (used as safety devices).
If any of these is released the cutter will stop. The first micro-switch is on a guard, if this is opened the machine will stop. The second micro-switch is on a door which allows access to the moving mechanism of the milling machine.
If this is opened the machine will stop.
The micro-switches are normally logic ‘1’ (true, high, on) when pressed.



10.4.1 Complete the logic diagram for this machine.



10.4.2 Is having an ON and OFF switch on the floor a clever idea? _____

10.4.3 Give a reason for your answer.

_____

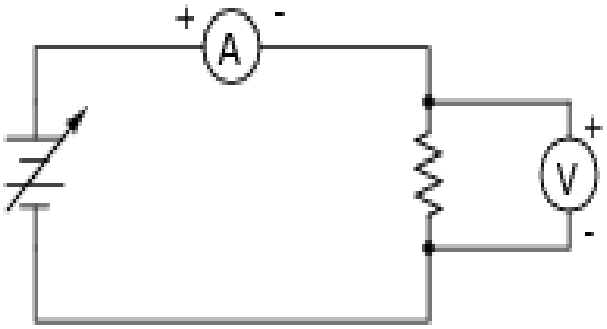
_____

10.4.4 How would you improve the design of the switch to make the machine safe to use?

_____

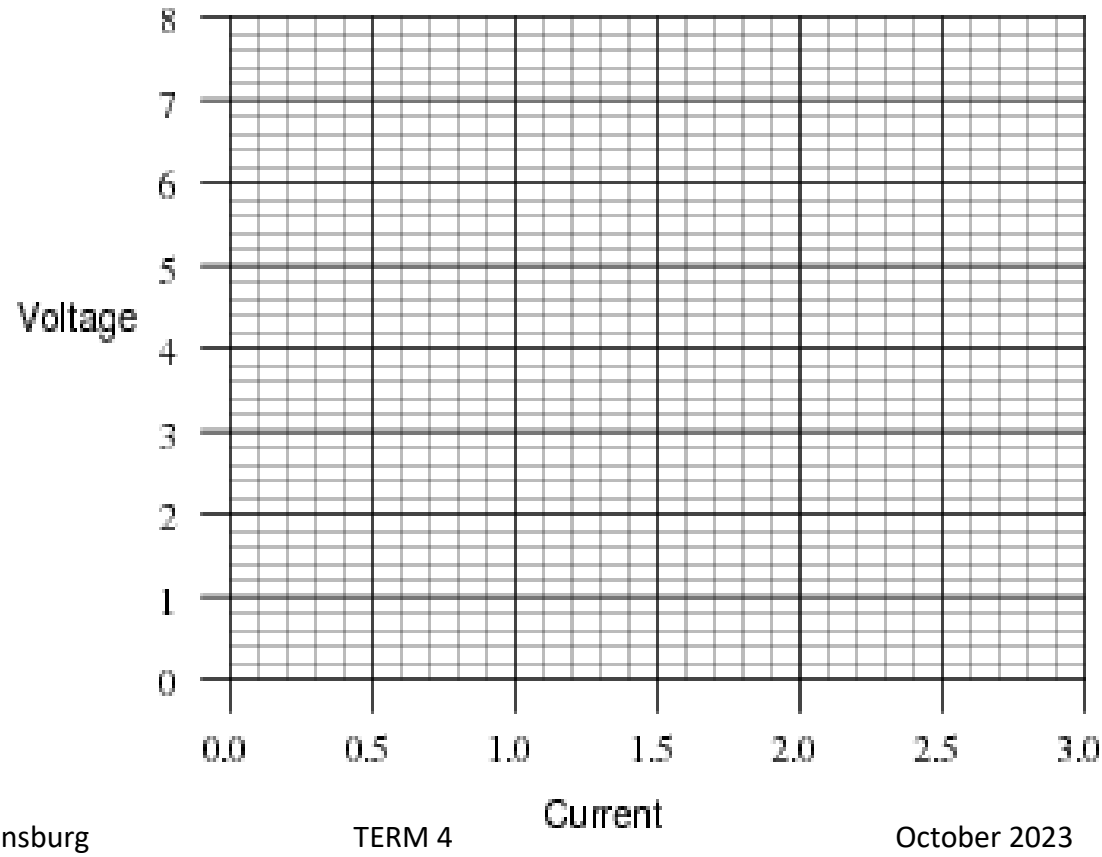
_____

10.5 OHM'S LAW. Suppose you were to build this circuit and take measurements of current through the resistor and voltage across the resistor:
The recordings of the numerical values are indicated the table.

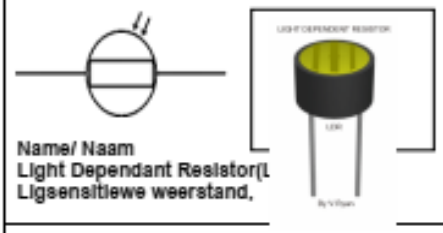
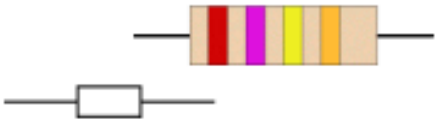
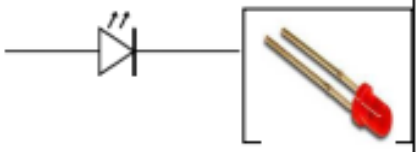
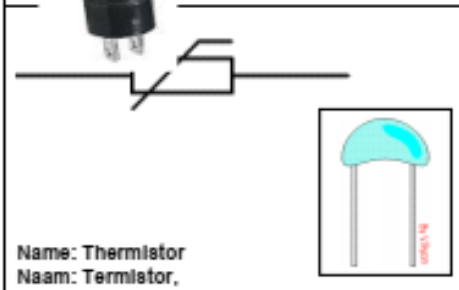
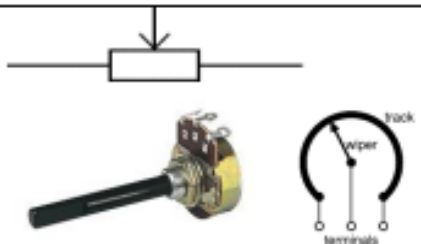
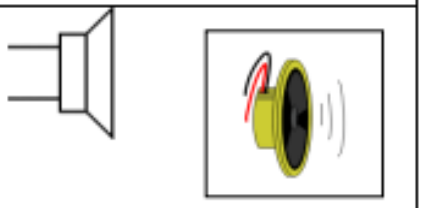
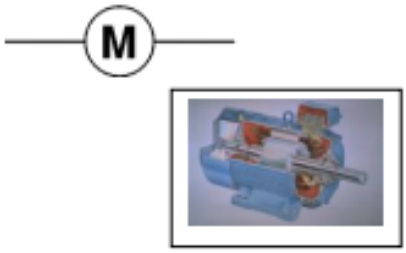
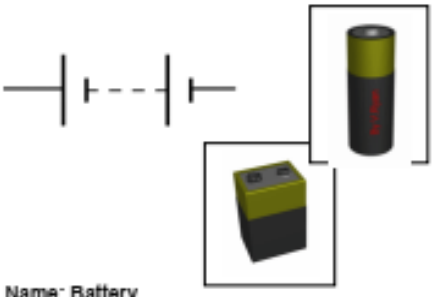
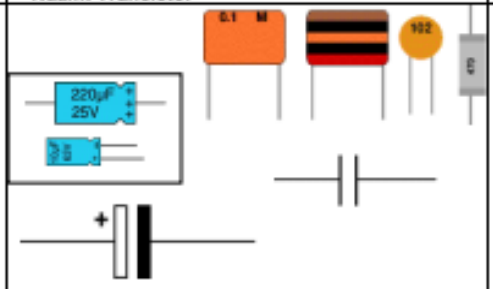
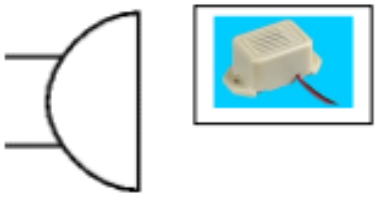
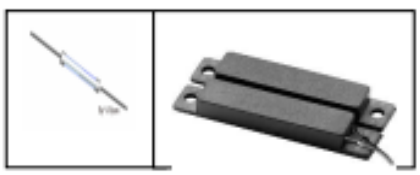
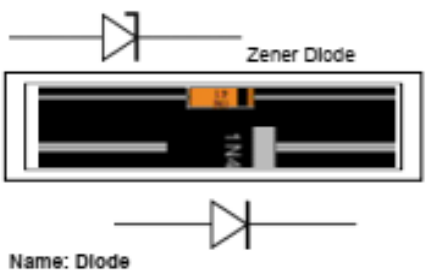
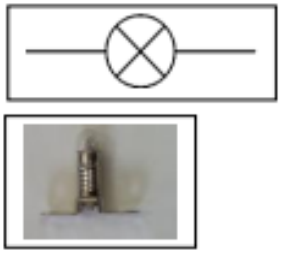


CURRENT	VOLTAGE
0.22 A	0.66 V
0.47 A	1.42 V
0.85 A	2.54 V
1.05 A	3.16 V
1.50 A	4.51 V
1.80 A	5.41 V
2.00 A	5.99 V
2.51 A	7.49 V

10.5.1 Plot these figures on the following graph:



ELECTRONIC DEVICES AND SYMBOLS
ELEKTRONIESE KOMPONENTE EN SIMBOLE

INPUT(S) / INSET	PROCESS / PROSESSERING	OUTPUT(S) / UITSET
 Name/ Naam Light Dependant Resistor(L Ligsensitiewe weerstand,	 Name: Resistors Naam: Weerstand	 Name: Light Emitting Diode (LED) Naam: Gliмdiode / Ligemissiediodes
 Name: Push switch Naam: Druk Skakelaar	 Name: Microchip Naam: Mikroskyfie / geintegreerde stroom	 Name: Solenoid Naam: Solenoïde
 Name: Thermistor Naam: Termistor,	 Name: Variable resister / Potentiometer Naam: verstelbare weerstand	 Name: Loudspeaker Naam: Luidspreker
 Name: Microphone Naam: Mikrofoon	 PNP (In CAPS) NPN Name: Transistor Naam: Transistor	 Name: Motor Naam: Motor
 Name: Battery Naam: Battery	 Name: Capacitor Naam: Kapasitor	 Name: Buzzer Naam; Gonser
 Name: Magnetic switch Naam: Magnetiese skakelaar	 Zener Diode Name: Diode Naam: Diode	 Name: Bulb Naam: Gloeilamp

WEEK 7: SCENARIO, SPECIFICATIONS & CONSTRAINTS

THE FISHER FAMILY FROM BO-KAAP

Many generations of the Fisher family have lived in Bo-Kaap for as long as anyone in the family can remember. Mr Fisher is the manager at the butchery a few blocks down the road. He has to be at work most mornings before 5 a.m. He usually gets home after 8 p.m. at night. Saturday is always the butchery's busiest day. So, in order to prepare for Saturdays, Mr Fisher works on Friday nights until 10 or 11 p.m. Mrs Fisher is therefore often alone at home with their three young daughters and Mr Fisher's mother of 86.

The Fisher's home has three bedrooms, a bathroom and a kitchen and a lounge. Mr Fisher wants to install an alam system to his house.

Design and make an alarm system that is triggered by panic buttons placed strategically around the house. The alarm system will alert the neighours and security company when someone inside the house needs help.

REQUIREMENTS FOR THE ALARM SYSTEM

- The panic buttons must be installed in the three bedrooms, kitchen and dining room.
- The alarm system must be activated with any of the panic
- The circuit must include an AND & a OR logic gates.
- The components of the alarm system should not exceed R150.
- The alarm system should consist of:
  a 9V battery,
  switches,
  a buzzer,
  connecting wires

Answer the following questions.

11.1 What is die **problem**?

_____

_____

11.2 Write a proper design brief for the alarm system.

_____

_____

_____

11.3 List *three specifications* for the alarm system.

11.4 *List one constraint* for the alarm system.

11.5 Design a circuit diagram for the alarm system.

- Include five panic buttons (switches) in your design.
- Use the correct symbols for the different components of the circuit diagramme.

11.6 Draw the truth table for the device.

11.7 Design a poster for your device where you advertise the panic button.