ELECTRICAL CIRCUITS

Name: ______________________________

Cell number: _______________________

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UNITS AND SYMBOLS

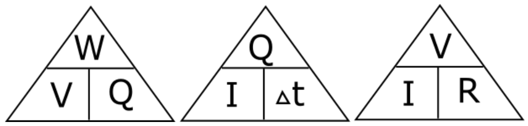
Potential difference (**V**)	Volt (**V**)	Charge (**Q**)	Coulomb (**C**)
Current strength (**I**)	Ampère (**A**)	Time (**Δt**)	Seconds (**s**)
Resistance (**R**)	Ohm (**Ω**)	Power (**P**)	Watt (**W**)
Labor (**W**) and Energy (**E**)	Joule (**J**)		

SUMMARY: LAWS AND DEFINITIONS

DEFINITIONS:	
Coulomb's law	The size of the electrostatic force that one point charge exercises onto another point charge is directly even to the product of the sizes of the charges and conversely even to the square of the distance between them.
Electrical field at a point	The electrostatic force experienced per unit's positive charge placed at that point.
Ohm's law	The potential difference over a conductor is directly even to the current through the conductor at a constant temperature.
WGK	The wgk-value of WS is the GS-potential difference/current that uses the same amount of energy as the WS.

	SERIES CIRCUIT	**PARALLEL CIRCUIT**
Current strength measured in Ampere (A) **Symbol : I**	I has the same value everywhere in the series circuit. $I_T=I_1=I_2=I_3$	The circuit in a parallel circuit splits into the 2 or more branches/ extensions (indirectly even to the size pf the resistance) (**Current divider**)
Potential difference measured in Volt (V) **Symbol: V**	The volt meter readings are added up to determine the total Volt meter reading of the series circuit. $V_T=V_1+V_2+V_3$ (**Potential divider**)	The volt meter readings remain the same for all the parallel branches in the circuit. $V_T=V_1=V_2=V_3$
Resistance measured in Ohm (Ω) **Symbol: R**	All the resistors in a series circuit must be added up to determine the total resistance of the series circuit. $R_T=R_1+R_2+R_3$	Here you have to calculate the equivalent resistance of a resistance in Series. $\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$

Important formulas:



Important:

- **Current** is the pace at which charge flows.
- **Potential difference** is the labor done per unit positive charge. When 1 J energy is needed to move 1 coulomb charge between two points, there is a potential difference of 1 V ($V = \frac{W}{q}$).
- **Resistance** is a material's resistance against the flow of a current. When a conductor transmits a current of 1 A if there is a potential difference of 1 V over its points, the conductor has a resistance of 1 Ω ($\frac{V}{I} = R$). The **internal resistance** of the cell is the resistance presented against the flow of charge.
- An **Ohmic conductor** is one that obeys Ohm's law.
- A **Non-ohmic conductor** is one that disobeys Ohm's law.
- **Emk** is the total energy produced per coulomb charge through the cell ($V = \frac{W}{q}$).

IMPORTANT FACTS TO REMEMBER

- **Current in series** circuit is **the same everywhere.**
- If a **volt meter is connected over a parallel liaison** the volt meter fits with **every branch** and with the **total resistance** of the parallel liaison.
- The **resistance of a volt meter is very big** – does not allow any current flow.
- The **resistance of an ammeter is very small** – the main current always flows through.
- If **I = 0** and a **voltmeter makes contact with both poles** of the cell, **the volt meter reads the EMK of the cell.**
- If **current flows**, the **volt meter cannot take a reading over the cells.**
- **EMK is the maximum energy that the cell can deliver for every Coulomb charge.**
- The **bigger the resistance** in a circuit, the **smaller the current**.
- The **more cells connected in series**, the **bigger the total resistance**.
- The **more resistors connected in parallel**, the **smaller the total resistance**.

EMK AND INTERNAL RESISTANCE

In an open circuit the volt meter shows the emk.

In a closed circuit the volt meter reading decreases, the meter now shows $V_{external}$.

The difference between the two readings represents the tension over the internal resistance.

Emk = I(R+r)

The current in a circuit can be determined if:

A **resistor size** and the **potential difference** over the resistor is known ($\frac{V}{R}$ = I).

The **internal resistance** and **internal tension** is known ($\frac{Vintern}{r}$ = I).

All **resistor sizes** and the **emk** is known ($\frac{emk}{Rtot + r}$ = I).

The **total external resistance** and **potential difference** over the battery is known … ($\frac{Veks}{Rtot}$ = I).

Relationship between Current, Potential difference and Resistance

Ohm's Law

- The potential difference over a resistor is directly even to the current that flows through the resistor provided that the temperature remains constant.
- V α I

  OR
- V = IR

  OR
- R = V/I

From Ohm's Law

- R α 1/I : The bigger the resistance, the smaller the current will become.
- Therefore R and I are inversely even to one another.

From Ohm's Law

- ε = Vexternal + Vinternal
- ε = IR + Ir
- ε = I(R + r)
- R = ε – R / I

Power

- Power is known as the pace at which electric energy is displaced.
- P = VI

  OR
- $P = I^2R$

  OR
- $P = V^2/R$

Power explained

- Power can be explained by an example – If it says 220V, 40W on a light bulb, it means that when the light bulb reaches a potential difference of 220V, 40J energie is being emitted per second.
- $1W = J.s^{-1}$

R α V:

- R and V are directly even to one another.
- Therefore, the bigger the resistance, the bigger the potential difference over the resistor where it will be measured.

Symbols

- R = resistance in ohm (Ω)
- V = Potential difference in volt (V)
- I = Current in ampere (A)
- r = internal resistance
- P = Power in watt (W)

Emk of battery measurement

- If no current is flowing and you connect a voltmeter directly over the poles of the battery, there will be no potential difference over the internal resistance of the battery.
- The voltmeter reads the potential difference over the poles(terminals) of the battery.

Internal Resistance (r)

Because energy is needed to let charge move through a battery, any battery (as a source of Emk) also has a resistance.

Emk (ε)

When energy is needed to allow electric charge to move through a current, that is known as Emk.

Ohmic Conductor

Here Ohm's law is applicable and the ralationship V/I remains constant for all the values of V and I, on the condition that the temperature of the conductor remains constant.

If the current is closed

More than 1 resistance, collectively equal to the emk which is less than the emk of the battery

Non-Ohmic Conductor

In such a conductor the relationship does not constantly remain V/I and Ohm's law is not applicable here.

Resistors in Series/Paralle

Resistors in Series and Ohm

- The equivalent resistance is equal to the sum of all the individuals resistances.
- $R_{ekw/T} = R_1 + R_2 + R_3$

Resistors in Series and Ampere

- Ampere = In a series current the same current flows through every resistor.
- I deur R_1 = I deur R_2 = I deur R_3 = $I_{hoofstroom}$.

Resistors in Series

- Volt = The sum of the potential differences over every resistor is equal to the potential difference over the battery.
- $V_T = V_1 + V_2 + V_{3v}$
- If you apply Ohm's law: $V_T = IR_{ekw} = IR_1 + IR_2 + IR_3$
- Resistors in series is also known as potential dividers, meaning the potential difference (V_T) of the battery is divided over each resistor and it has the same relationship as their resistance values.

Resistors in Parallel and Ohm

- The following formula can be used to calculate the equivalent resistance:
- $1/R_{parallel} = 1/R_1 + 1/R_2 + 1R_3$

From Ohm's law

- $R_{ekw} = 1/I$
- The more resistors connected in series, the larger the equivalent resistance gets, the main current also decreases in the circuit.
- No current will flow if one resistor is broken.

Resistors in Parallel and Ampere

- The main current is divided if it reaches parallel joining:
- $I_T = I_1 + I_2 + I_{3n}$
- Resistors in parallel are current dividers.

Potential difference-divider Formula

The potential difference at a resistor = resistance at the resistor/ the total resistance x(times) the total potential difference.

Resistors in Parallel and Volt

- If there is only resistors in parallel, but none elsewhere in the circuit, all the voltmeter readings will be the same.
- $V_{parallel} = V_1 = V_2 = V_3$
- If the battery has internal resistance when there are more resistors connected in parallel in the circuit, that will cause an increase in I and a decrease in R through R and r.
- $\varepsilon = V_{battery} + V_{internal\ resistance} = RI = rI$

Current divider Formula

Current through the resistor = parallel resistance / resistor's resistance x(times) the main current.

From Ohm's law

- $R \alpha 1/I$
- A large current will be let through by a resistor with the smallest resistance.
- The more resistors, the larger the main current becomes and the smaller the equivalent resistance becomes.
- The current will still flow if one resistor in parallel breaks.
- If there are only 2 resistors, the one remaining will nou be in series.