Highsted Knowledge Organiser Physics: Electric Circuits

What I need to know
Definitions
Rules of Series and Parallel circuits.
Recall of practicals
Labelling of diagrams
How to use the equations

Key Vocabulary:

Current: The rate of flow of electrical charge.

Potential difference: The energy transferred to a component by each coulomb of charge that passes through it.

Ohms Law: The current through a resistor at constant temperature is directly proportional to the potential difference across it
Resistance increases as current increases.
Resistance increases as temperature increases.
The ions in the metal filament vibrate more as temperature increases. So they resist the passage of electrons more.

Equations

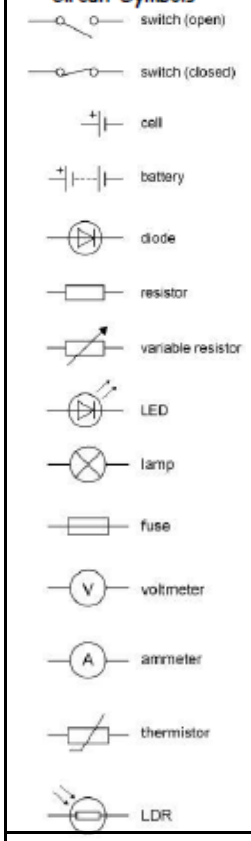
Charge flow = Current x time
$Q = I \times t$

Potential difference = Current x Resistance
$V = I \times R$

Energy transferred = Charge Flow x Potential Difference
$E = Q \times V$

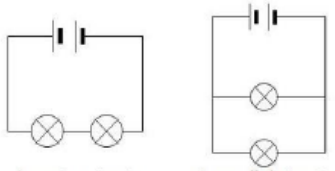
Student reference point

Circuit Symbols



The greater the **resistance** of a component the smaller the current for a given potential difference across the component.

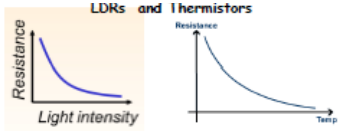
Series and Parallel Circuits



In a series circuit:
Current is the same through each component
The total potential difference of the power supply is shared between components
The total resistance of two components is the sum of the resistance of each component
$R_{total} = R_1 + R_2$

In a parallel circuit:
The potential difference across each component is the same
The total current through the whole circuit is the sum of the currents through the separate components
The total resistance of two resistors is less than the resistance of the smallest individual resistor.

LDRs and Thermistors



The resistance of an LDR (light dependent resistor) decreases as light intensity increases. LDRs are used in turning on streetlights.

The resistance of a thermistor decreases as the temperature increases. Thermistors are used in thermostats.

Resistance of a wire Required Practical

Aim; Investigate factors affecting the resistance of electrical circuits including the length of a wire at constant temperature and combinations of resistors in series and parallel.

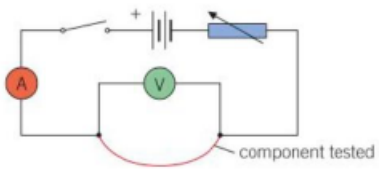
Independent Variable: Length of wire

Dependent Variable:
Current and potential difference to calculate resistance

Control variables:
Thickness of wire
Wire material
Temperature

Equation: V = I x R

Equipment



Method

- Set up the circuit as per the diagram with a 10cm wire.
- Set the power supply to 2V
- Close the switch and record the current and potential difference on the ammeter and voltmeter
- Repeat for 20cm,30cm,40cm and 50cm.
- Calculate the resistance for each length using the equation R=V/I
- Plot a graph of Resistance vs Length of wire.

I-V Characteristics Required Practical

Aim; Investigate I-V characteristics of a varity of circuit elements

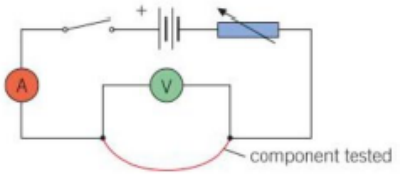
Independent Variable: Circuit component

Dependent Variable:
Current and potential difference

Control variables:
Temperature

Equation: V = I x R

Equipment

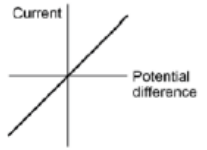


Method

- Set up the circuit as per the diagram with the component to be tested as a Fixed Resistor.
- Set the power supply to 2V.
- Close the switch and record the current and potential difference on the ammeter and voltmeter.
- Repeat for a range of potential differences, by adjusting the variable resistor.
- Reverse the direction of the power supply and repeat the experiment.
- Plot a graph of potential difference vs current.
- Repeat for a Bulb and diode.

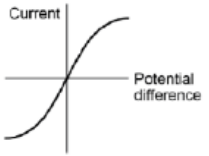
- Charge flow, Q, in Coulombs, C
- Current, I, in amperes, A
- Time, t, in seconds, s
- Potential difference, V, in volts, V
- Resistance, R, in Ohms, Ω
- Energy transferred, E, in Joules, J

I-V Characteristics Required Practical Results



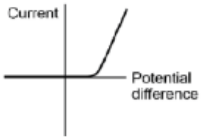
I-V Characteristics for a fixed resistor (linear)

The resistance of a filament lamp increases as the temperature of the filament increases



I-V Characteristics for a Filament Bulb (non-linear)

The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction.



I-V Characteristics for a Diode

Challenge question: From memory—Write out the method to investigate the resistance across a fixed resistor (6marks)

Suggested reading: Electrical circuit symbols - Electric circuits - AQA - GCSE Combined Science Revision - AQA Trilogy - BBC Bitesize

Highsted Knowledge Organiser Physics: Electric Charge

What I need to know
Definitions
Recall of practicals
Labelling of diagrams
How to use the equation

Key Vocabulary:

Current: The rate of flow of electrical charge.

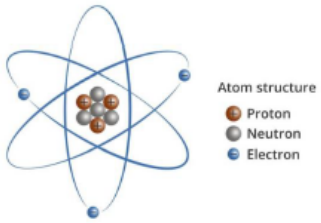
Equations

Charge flow = Current x time
$Q = I \times t$

- Charge flow, Q, in Coulombs, C
- Current, I, in amperes, A
- Time, t, in seconds, s

Student reference point

Static Electricity



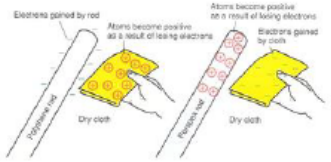
Protons are positive. Electrons are negative.

Only electrons move!

Negative electrons are rubbed off one material and on to another.
The material that gains electrons becomes negative.
The material that loses electrons becomes positive.

For example, when a polythene rod is rubbed with a duster, electrons move from the duster to the rod.

- **the polythene rod has gained electrons, giving it a negative charge**
- **the duster has lost electrons, giving it a positive charge**



If the rod is swapped for a different material such as perspex, **electrons are rubbed off the perspex and onto the duster.**

Electric Forces

Like charges repel

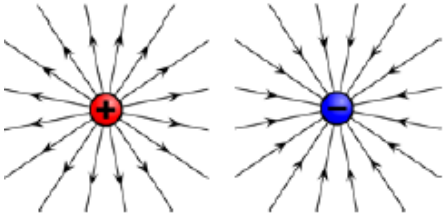
Opposite charges attract

A charged object will experience a **non-contact** force from another charged object. This force is called the **Electrostatic Force.**

Electric Fields on charged objects

A charged object creates an electric field around itself.

The direction of the arrow indicates whether the charge is positive or negative.



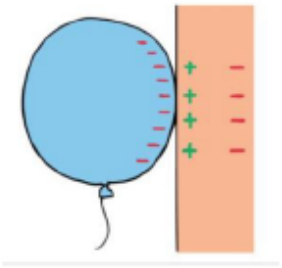
A second charged object placed in the field experiences a force

The separation of the field lines shows how strong the force is. The closer the field lines are together the stronger the force a charged object will feel.

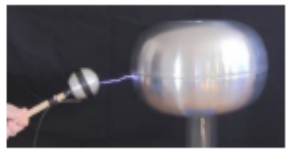
The force gets stronger as the distance between the charged objects decreases.

Examples of Electrostatic forces.

Charged objects exert forces on one another.
A balloon stuck to a wall is evidence that charged objects exert forces of attraction.
The negatively charged balloon is attracted to the positive ions of the wall, and repels the negative electrons.



The build of charge on an insulator can lead to sparking. Lightning and a Van de Graff generator are both examples of this.



Challenge question: Explain why you sometimes get an electric shock when you get out of a car. (3marks)

Suggested reading: Static Charge - an overview | ScienceDirect Topics

Highsted Knowledge Organiser Physics : Electricity in the home

What I need to know
Label plug
Role of wires and pins
How to use the equations and link equations
Difference between ac and dc.
Role of transformers in the national grid

Key Vocabulary:

A battery is a **dc (direct current)** supply. A direct potential difference causes the current to **flow in one direction** only.

Mains electricity is an **ac (alternating current)** supply. An alternating potential difference causes current to **periodically reverse its direction.**

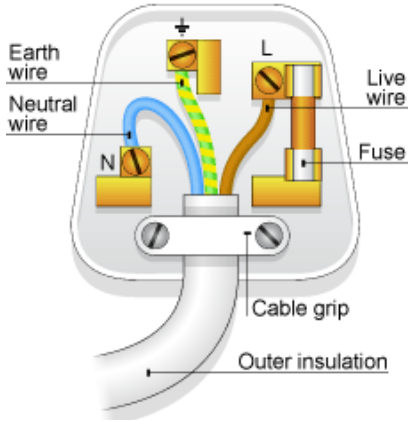
Equations

Energy transferred = Charge Flow x Potential Difference
$E = Q \times V$

Energy transferred = power x time
$E = P \times t$

Power = potential difference x current
$P = V \times I$

Student reference point



Live wire; Brown;
The live wire carries the alternating potential difference from the supply. Potential difference between the live wire and earth is 230V.

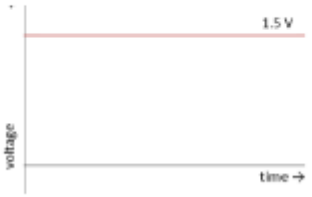
The live wire is dangerous. Touching the live wire and making a connection to earth causes a person to be electrocuted, which can be fatal.

Neutral wire; Blue
The neutral wire completes the circuit and has a potential difference of 0V

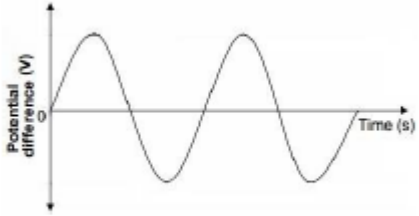
Earth wire; Green and yellow stripes
The earth wire has a potential difference of 0V. It only carries a current if there is a fault. The earth wire is a safety feature.

Alternating and direct current

A battery is a **dc (direct current)** supply. A direct potential difference causes the current to **flow in one direction** only.



Mains electricity is an **ac (alternating current)** supply. An alternating potential difference causes current to **periodically reverse its direction.**

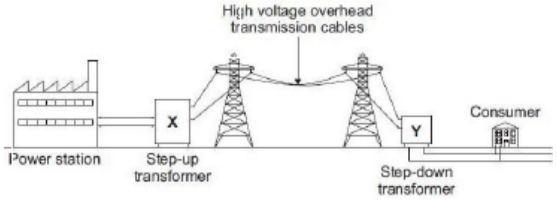


The mains supply has a frequency of **50Hz** and has a supply potential difference of **230V.**

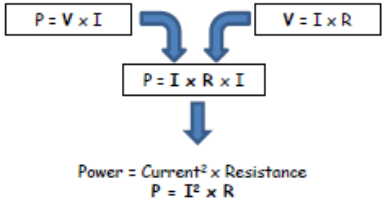
Electrical power is transferred from power stations to consumers using the national grid. **Step up** transformers increase the potential difference in the transmission lines.

A high Potential difference means a **low current**

Low current means less **energy** is lost through heating the wire, so is a more **efficient way to transfer energy.**



Step down transformers decrease the potential difference to a safer voltage for use in homes.



Power = Current² x Resistance
$P = I^2 \times R$

- Charge flow, Q, in Coulombs, C
- Current, I, in amperes, A
- Time, t, in seconds, s
- Potential difference, V, in volts, V
- Resistance, R, in Ohms, Ω
- Energy transferred, E, in Joules, J
- Power, in Watts, W

The amount of energy an appliance transfers is dependent on how long the appliance is switch on for and the power of the appliance.

The power of an appliance is related to:

- The potential difference across it and the current through it
- The energy transferred in a given time.

Challenge question: Explain the roles of the step up and step down transformers inn the National grid. (6marks)

Suggested reading: Electricity - 2.4.3 The National Grid (GCSE Physics AQA) - Study Mind