# Electricity IB Physics Content Guide

## Big Ideas

- Electricity consists of charged particles moving in a continuous circuit
- Voltage, Current, and Resistance are related to each other though Ohm's Law
- The total current flowing into a junction must equal the total current flowing out of that same junction
- The voltage dropped around a continuous loop traced in a circuit must equal the voltage provided
- Resistors can be combined in different ways to produce different results
- It is possible that the act of taking a measurement will change the value being measured
- The resistance of a wire is affected by its thickness, length, and material resistivity

## Content Objectives

### 1 – Electrical Current

| | | | |
|---|---|---|---|
| I can quantify charge in terms of Coulombs | | | |
| I can calculate the charge of a certain # of electrons and the # of electrons for a given charge | | | |
| I can describe current in terms of amps and coulombs per second | | | |
| I can describe the subatomic properties of a conductor to allow charge to flow | | | |
| I can the electron drift speed for a given current and wire | | | |

### 2 – Electrical Properties

| | | | |
|---|---|---|---|
| I can describe the properties of Voltage, Current, Resistance, and Power | | | |
| I can use Ohm's Law to mathematically relate these electrical properties and solve for an unknown | | | |

### 3 – Circuits

| | | | |
|---|---|---|---|
| I can describe the direction of conventional current compared to the movement of charges | | | |
| I can identify component combinations as parallel or series | | | |
| I can describe how current flows through parallel and series resistors | | | |
| I can describe the set up to measure current and voltage in a circuit | | | |

### 4 – Calculating Resistance

| | | | |
|---|---|---|---|
| I can describe the property of resistivity and how it and the wire dimensions affect resistance | | | |
| I can calculate the equivalent resistance for combinations of resistors in series and parallel | | | |
| I can step through the calculation of the equivalent resistance for a complex combination | | | |

### 5 – Voltage Dividers and Batteries

| | | | |
|---|---|---|---|
| I can use Kirchhoff's First Law to determine an unknown current at a junction | | | |
| I can use Kirchhoff's Second Law to determine an unknown current at a junction | | | |
| I can calculate voltage, current, and resistance for every component in a series or parallel circuit | | | |
| I can compare and contrast the properties for simple series and parallel circuits | | | |

## 6 – Potential Dividers

| | | | |
|---|---|---|---|
| I can identify the different circuit diagram symbols for different types of resistors | | | |
| I can describe how environmental changes can affect the resistance of LDRs and Thermistors | | | |
| I can describe how changing resistor values can affect the voltage drop in a potential divider circuit | | | |
| I can design a potential divider circuit to perform a certain task | | | |

## 7 – Voltage Dividers and Batteries

| | | | |
|---|---|---|---|
| I can connect a meter to measure current or voltage | | | |
| I can describe the conditions required for an ideal ammeter or voltmeter | | | |
| I can calculate for a situation when the meter isn't ideal | | | |

## 8 – Batteries

| | | | |
|---|---|---|---|
| I can describe the difference between primary and secondary cells | | | |
| I can define the electromotive force and describe how is it is different than terminal voltage | | | |
| I can solve for a circuit that includes a battery with internal resistance | | | |

# Electricity

Shelving Guide

## Charge

| Symbol | | Unit | |
|---|---|---|---|
| Charge of 1 Electron | | | |
| # of Electrons per Coulomb | | | |

## Current

| Symbol | | Unit | |
|---|---|---|---|
| Unit in terms of Coulombs | | | |

## Drift Speed

| | Variable Symbol | Unit |
|---|---|---|
| Current | | |
| # of Electrons per $m^3$ | | --- |
| Cross Sectional Area | | |
| Drift Speed | | |
| Charge | | |

*Data Booklet Equation:*

$$I = nAvq$$

Cross Sectional Area:

$A =$

## Electrical Properties

| Property | What is it? | Symbol | Unit |
|---|---|---|---|
| Voltage | | | |
| Current | | | |
| Resistance | | | |

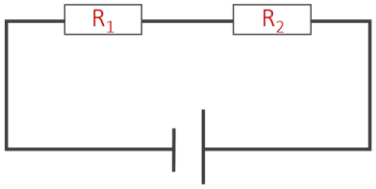
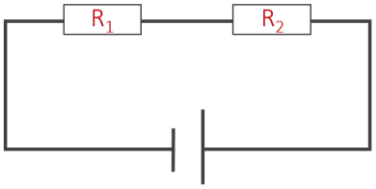
## Power

| In terms of V and I | In terms of I and R | In terms of V and R |
|---|---|---|
| $P =$ | $P =$ | $P =$ |

## Ohm's Law

| | | |
|---|---|---|
| $V =$ | $I =$ | $R =$ |

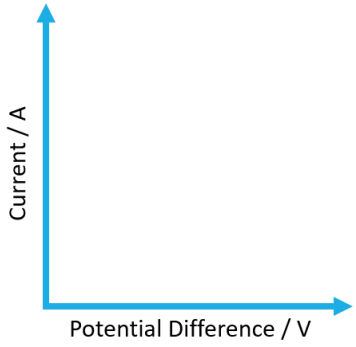
## Measuring Circuits

| | Ammeter | Voltmeter |
|---|---|---|
| Ideal Resistance | | |
| How is it connected to the component being measured? | | |
| Drawing of meter measuring $R_1$ |   |   |

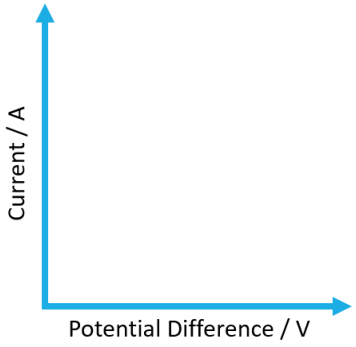
## Resistivity

| | Variable Symbol | Unit |
|---|---|---|
| Resistivity | | |
| Resistance | | |
| Cross Sectional Area | | |
| Length | | |

*Ohmic Resistor*




*Non-Ohmic Resistor*




*Data Booklet Equation:*

$$\rho = \frac{RA}{L}$$

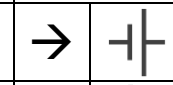
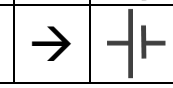
Cross Sectional Area:

$$A =$$

## Equivalent Resistance

| | Drawing with $R_1$ and $R_2$ | Equation |
|---|---|---|
| Series | | |
| Parallel | | |

## Kirchhoff's Laws

| $\Sigma I = 0 \ (junction)$ | $\Sigma V = 0 \ (loop)$ |
|---|---|
| | Across resistors |
| Entering Junction → • | Negative to Positive →  |
| Exiting Junction • → | Positive to Negative →  |

## Voltage Dividers

| | Light-Dependent Resistor | | Thermistor | |
|---|---|---|---|---|
| Symbol | | | | |
| Relationship | Light | Increases | Heat | Increases |
| | Resistance | | Resistance | |
| Circuit | Switch turns on in the dark: | | Switch turns on in a fire: | |

## Batteries

| Primary Cells | Secondary Cells |
|---|---|
| | |

| | Variable Symbol | Unit |
|---|---|---|
| Electromotive Force (e.m.f) | | |
| Current | | |
| Circuit Resistance | | |
| Internal Resistance | | |

*Data Booklet Equation:*

$$\varepsilon = I(R + r)$$