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 resistance of a wire is affected by its thickness, length, and material resistivity
- 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 add up to 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

1 – Electrical Properties

I can describe the properties of Voltage, Current, Resistance, and Power			
I can quantify current through a representation of charge of numbers of electrons			
I can relate energy and voltage conceptually and mathematically			
I can mathematically relate the electrical properties and solve for an unknown			

2 – 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			

3 – 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 equivalent resistance for a complex combination			

4 – Circuit Analysis

I can use Kirchhoff's First 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 the properties for simple series and parallel circuits			

5 – 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			

6 – Non-Ideal Meters

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			

7 – Batteries

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

Defining Current and Voltage

	Variable Symbol	Description	Unit
$I = \frac{\Delta q}{\Delta t}$	I		
	Δq		
	Δt		

Charge of 1 Electron		# of Electrons per Coulomb	

Potential difference is defined as the work done (energy transferred) when one unit of positive charge moves between two points along the path of the current

	Variable Symbol	Description	Unit
$V = \frac{W}{q}$	V		
	W		
	q		

Electrical Properties

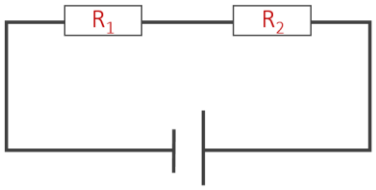
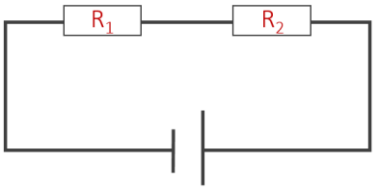
Property	What is it?	Symbol	Unit
Voltage			
Current			
Resistance			
Power			

Power Formula	Ohm's Law		
$P = IV = I^2R = \frac{V^2}{R}$	$V =$	$I =$	$R = \frac{V}{I}$

Resistivity

	Variable Symbol	Description	Unit
$\rho = \frac{RA}{L}$ $A_{circle} =$	ρ		
	R		
	A		
	L		

Measuring Circuits

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

Equivalent Resistance

	Drawing with R_1 and R_2	Equation
Series		
Parallel		

Circuit Analysis

	Series Circuits	**Parallel Circuits**
Current		
Voltage		

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	Description	Unit
$\varepsilon = I(R + r)$	ε		
	I		
	R		
	r		