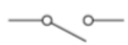
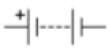
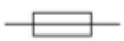
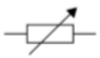
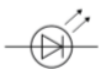
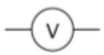
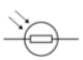
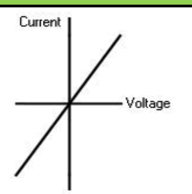
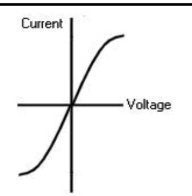
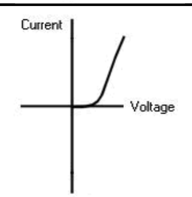
Subject: A-level Physics	Topic: Electricity	Year Group: 12

Circuit symbols

1	 cell	8	 switch (open)
2	 battery	9	 switch (closed)
3	 lamp	10	 resistor
4	 fuse	11	 variable resistor
5	 diode	12	 thermistor
6	 LED	13	 voltmeter
7	 LDR	14	 ammeter

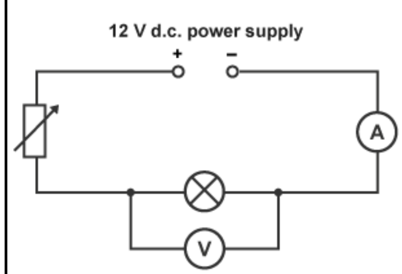
Current-Voltage graphs

1		**Resistor at a constant temperature** $I \propto V$ Obeys Ohm's law. Is an ohmic conductor.
2		**Filament lamp:** As the *I* increases the filament heats up meaning R increases. This is because the energy transfer increases the lattice vibrations, leading to more frequent collisions between the e⁻ and lattice ions.
3		**Diode:** Forward bias - R is initially very high, resulting in a small *I*. At about 0.7 V the R rapidly decreases meaning *I* increases rapidly. Reverse bias - R is very high, giving almost zero current until the breakdown current after which R~ 0 leading to large *I*.

Circuit basics

1	Series circuits have one loop. Parallel circuits have two or more loops.
2	Conventional current flows from positive to negative BUT the electrons actually move from negative to positive.
3	Resistance is caused by collisions between the charge carriers in the material with each other and the fixed positive ions in the material through which the current is flowing.

I-V graph practical

1	This is the set-up needed to collect the results for a filament lamp.	
2	The variable resistor is adjusted to give a range of I and V values.	
3	Repeat for at least 6 different I and V values.	
4	To obtain negative readings, reverse the connections to the power supply.	
5	You can determine the resistance from an I-V graph by doing R = I/gradient. Or if voltage is on y-axis and current on x-axis R = gradient.	

Thermistors and LDRs

1	Thermistors and LDRs are made from semiconductors which are materials with a limited number of charge carriers.
2	As semiconductors are supplied with energy electrons can gain enough energy to become free to move through the material.
3	Thermistors (NTC) are devices whose resistance drops at temperature increases.
4	LDRs are devices whose resistance drops as light intensity increases.

Key equations

1	Current	$I = \frac{Q}{t}$
2	Potential difference	$V = \frac{W}{Q}$
3	Potential difference	$V = IR$
4	Power	$P = IV = I^2R = \frac{V^2}{R}$
5	Energy	$E = Pt = IVt = I^2Rt = \frac{V^2t}{R}$
6	Efficiency	$= \frac{useful\ energy\ output}{total\ energy\ input} \times 100$ $= \frac{useful\ power\ output}{useful\ power\ input} \times 100$

Key Vocabulary

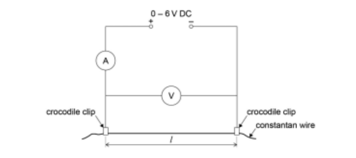
1	Current	The rate of flow of charge.
2	Potential difference (voltage)	The work done in moving a unit charge between two points.
3	Resistance	The ratio of the potential difference applied across a component to the current passing through it.
4	Ohm's law	Provided that the temperature and other physical conditions remain the same, the current through a conductor is directly proportional to the potential difference across it.
5	Power	The rate of energy transfer.
6	Efficiency	Measures how much of the energy supplied to a device is used usefully.

Beckfoot

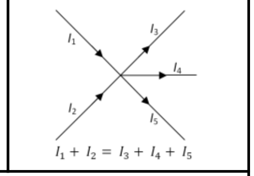
Subject: A-level Physics	Topic: Electricity	Year Group: 12

enjoy learn succeed

Resistivity

1	It depends on the material structure as well as environmental factors e.g. light and temperature. It is measured in Ωm.
2	Good conductors have small resistivities.
3	**Required practical: Determining the resistivity of a wire** 
4	Measure the diameter of the wire using a micrometer. Calculate the cross-sectional area. Set length = 0.100 m using a ruler. Set V = 0.5V and measure current. Calculate R using R = V/I. Repeat for different lengths. Plot a graph of R against length. The gradient is R/l, meaning resistivity is given by gradient x A.

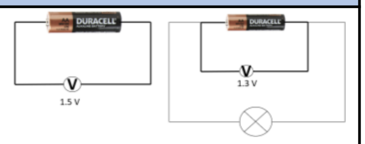
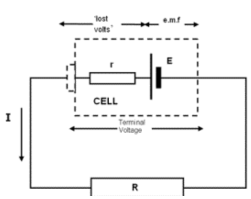
Kirchoff's laws

1	**Kirchoff's first law (conservation of charge):** At any junction in a circuit, the total current leaving the junction is equal to the total current entering the junction. 
2	This means that in a series circuit the current must be the same everywhere as current does not get used up.
3	**Kirchoff's second law (conservation of energy):** The sum of the potential differences around a circuit is equal to the sum of the emfs of the power source.
4	This means that in a series circuit the pd across components add up to the emf of the power source.
5	In parallel circuits the pd across parallel components is equal

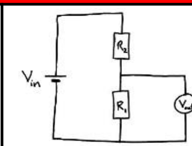
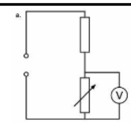
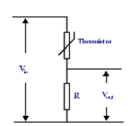
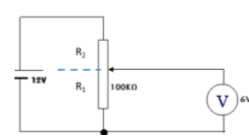
Key equations

1	Resistivity	$\rho = \frac{RA}{l}$
2	Cross-sectional area	$A = \pi r^2 = \pi \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$
3	Resistors in series	$R_T = R_1 + R_2 + R_3 + \cdots$
4	Resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$
5	Electromotive force	$\epsilon = I(R + r)$
6	Potential divider	$\frac{V_{out}}{V_{in}} = \frac{R_1}{R_1 + R_2}$

Internal resistance and emf

1	When no current flows the voltmeter reads 1.5 V. When a current flows the voltmeter reads 1.3 V. 
2	The missing volts are lost across the **internal resistance (r)** of the power supply. 
4	When current flows through a power source electrons collide with ions in the cell, transferring some energy by heating the internal resistance of the cell.
5	Emf is the energy transferred by a power source to each coulomb of charge. It is usually less than the voltage measured across the power supply (V_{term}).
6	To measure the emf of a power source measure the terminal potential difference when there is no current flowing.

Potential dividers

1	This is a simple potential divider. The power supply provides a fixed potential difference, V_{in}. BUT we don't want all this potential difference for our appliance. We use two resistors to get the output potential difference we need, V_{out}. 
2	 By altering R_1 and/or R_2 we can alter the output voltage. By replacing on of the fixed resistors with a variable resistor you can vary V_{out}.
3	 Here a resistor has been replaced with a thermistor. The output voltage depends on temperature. You could use a LDR instead meaning V_{out} depends on light intensity.
4	A potentiometer has a variable resistor replacing R_1 and R_2 of the potential divider. You move a slider or turn a button to adjust the relative sizes of R_1 and R_2. This is useful when you want to change the voltage regularly e.g. volume control of stereo. 

Key Vocabulary

1	Resistivity	A measure of how much a particular material resits current flow. It is equal to a material's resistance x cross-sectional area divided by its length.
2	Kirchoff's first law	At any junction in a circuit, the total current leaving the junction is equal to the total current entering the junction.
3	Kirchoff's second law	The sum of the potential differences around a circuit is equal to the sum of the emfs of the power source.
4	Electromotive force (emf)	The energy transferred by a power source to each coulomb of charge.
5	Internal resistance	The resistance between the terminals of a power supply which reduces the terminal pf when a current flows.
6	Superconductor	A conductor that has zero resistance at or below a **critical** temperature.
7	Potential divider	A pair of resistors that divide input pd in the ratio of the resistors.