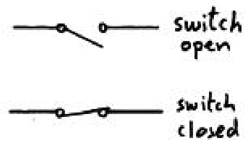
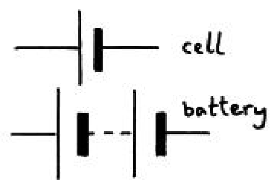
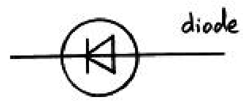
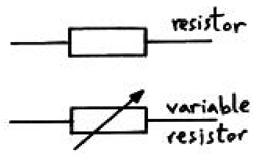
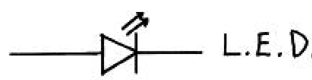
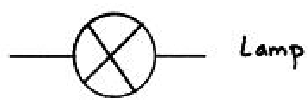
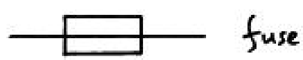
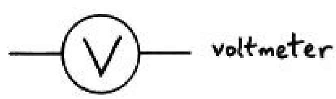
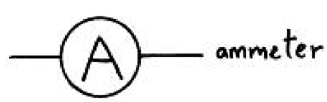
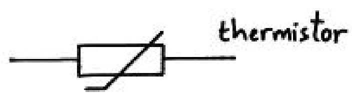
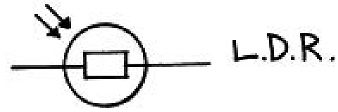
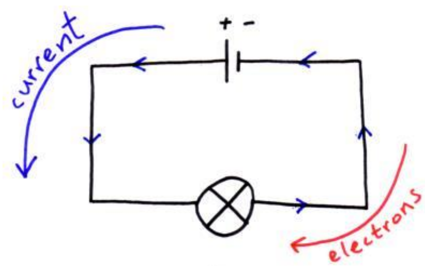
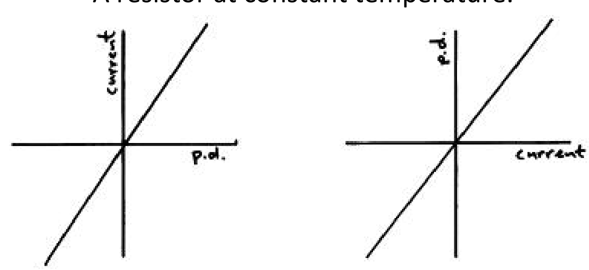
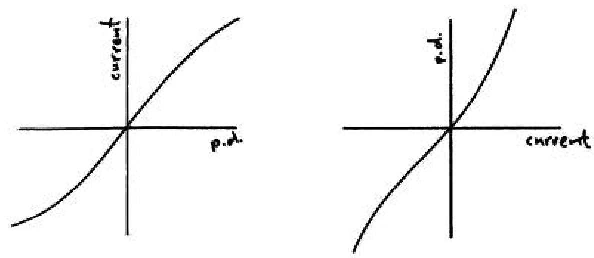
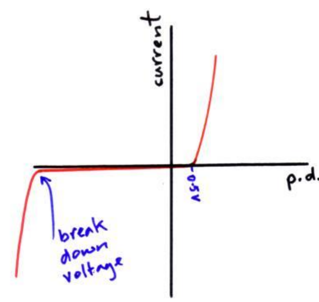
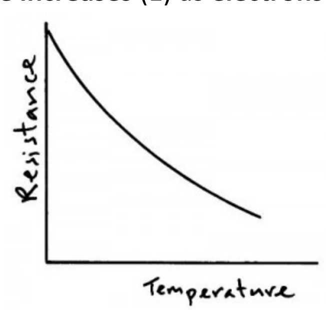
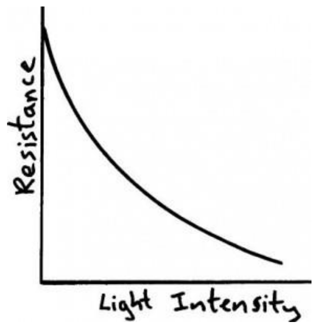
U5 - Electricity

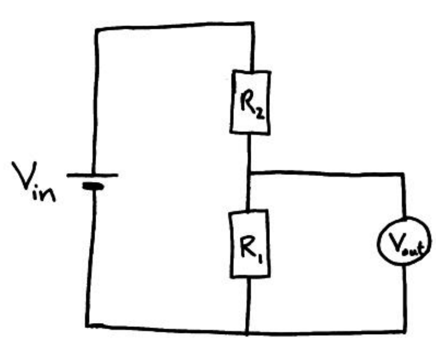
What is the circuit symbol of a switch?	
What is the circuit symbol of a cell/battery?	
What is the circuit symbol of a diode?	
What is the circuit symbol of both a resistor and variable resistor?	
What is the circuit symbol of a L.E.D?	
What is the circuit symbol of a lamp?	
What is the circuit symbol of a fuse?	
What is the circuit symbol of a voltmeter?	
What is the circuit symbol of an ammeter?	 *These ideally should have zero resistance.*
What is the circuit symbol of a thermistor?	

What is the circuit symbol of a L.D.R?	
What happens to both insulators and conductors when a voltage is applied across them and why?	● In **insulators**, **no current passes** ∵ electrons are **fixed**. ● In **metallic conductors**, **current passes** ∵ some electrons are **delocalised** (i.e., the charge carriers).
What is 1 C?	The **amount of charge** that flows via a point in **1 s** when there is a current of **1 A**.
What is current?	● The rate of the flow of charge. ● 1 A is 1 C flowing via a point every second.
What is current ∝ to under constant resistance and why?	The **emf** of the battery ∵ the **more energy** supplied to the charge carriers, the **faster** they will move.
How does charge flow? And how does the the flow of current differ?	● Charge flows from - to + due to repulsion and attraction. ● Current flows opposite to charge by convention.  *Always make conventional current on diagrams unless stated otherwise.*
What is potential difference and hence 1 V?	● The energy transferred (**work done**) **per unit of charge**. ● 1 V is 1 J transferred per coulomb of charge.
Why are voltmeters used in parallel?	Have a **very high resistance** ∴ you want as **little current to pass** through them ∴ you put them in parallel. *You still need a tiny bit of current to calculate voltage.*
When is maximum power delivered to the load?	When load resistance = internal resistance.
What can resistance be described as?	How hard it is for current to flow through a component.

	It being R = V/I means it's a measure of how much current you get for a particular p.d.
What is resistance caused by?	The repeated collisions between the charge carriers and positive ions.
Why does resistance lead to the material heating up?	**Energy** is **transferred** during the **collisions** between the charge carriers and the positive ions.
Why does an increase in temperature increase resistance?	Particles **vibrate more frequently** (1) ∴ **collide more frequently** with charge carriers (1) preventing them from flowing through so easily.
Why is resistivity useful?	It allows resistances of **different materials** to be **compared** when under the **same physical conditions**.
How does resistance vary with dimensions and why?	● It **increases with length** ∵ charge carriers have **more to flow through**. ● It **decreases with area** ∵ charge carriers have **more options** in taking the path of **least resistance**.
What is *Ohm's Law*?	"Provided physical conditions remain constant, the current via an ohmic conductor is directly proportional to the p.d. across it." *This means that doubling the p.d. doubles the current in the circuit (as the particles have more energy so move faster).*
What is a non-ohmic conductor?	A conductor whose resistance isn't constant.
Give an example of an ohmic conductor with its current-voltage graph	A resistor at constant temperature. 

Give the current-voltage graph of a filament bulb with an explanation	 Its **resistance increases** as it heats up due to **wasted energy**.
What does a diode do and how?	It **only allows current** to flow in the **forward direction** by having a very high resistance in the backwards direction.
What applications do diodes have?	To protect components in circuits.
Give the current-voltage graph of a diode with an explanation	 ● Has a t**hreshold voltage** of **0.60 V** before conduction. ● Can **conduct** in the **reverse direction** if the p.d. is high enough (this is its **breakdown voltage**).
Give an example of a semiconductor	A thermistor.
What key feature does a thermistor have, what does this mean and why?	**Negative temperature coefficient** (NTC) ⇒ its **resistance decreases** (1) as its **temperature increases** (1) as **electrons are released** (1). 
What happens to a LDR as light intensity changes?	Its r**esistance decreases** as its **light intensity increases**.

	
What is a superconductor defined as?	A material with **ZERO RESISTANCE** at or below its **critical temperature**.
Why are superconductors used (with examples)?	To have **NO ENERGY LOSSES** in machines with huge currents (e.g., in particle accelerators).
What is an intrinsic semiconductor?	A pure semiconducting material.
How does resistance work in series and why?	Total resistance = sum of all individual resistances ∵ $V_T = V_1 + V_2 \Rightarrow IR_T = IR_1 + IR_2 \Rightarrow R_T = R_1 + R_2$.
How does current work in series and why?	It is the **same wherever** you put the ammeter because it's a **rate**.
What is the effective resistance for parallel resistors and why?	● The reciprocal of the total resistance is equal to the sum of the reciprocals of the resistances of all the components. ● As it increases the possible routes for current to take thus making it easier for current to flow and thus the effective resistance smaller. *This is because you that know* $I_T = I_1 + I_2 \Rightarrow V / R_T = V / R_1 + V / R_2 \Rightarrow 1 / R_T = 1 / R_1 + 1 / R_2$
How does p.d. work in parallel and why?	**Same across all lines** ∵ it is merely the **energy transferred per coulomb of charge** which is the same for each coulomb.
How does current work in parallel and why?	It **splits up** at a junction **according to resistance**; **more current** will flow via the **least resistance** because voltage has to be constant. *Think of charge as being lazy, more will flow down the route with the least resistance.*
What is Kirchhoff's First Law?	"At any junction, the sum of the currents entering = the sum of the currents leaving."

	This is fundamentally a statement about the conservation of charge.
What is Kirchhoff's Second Law?	"In any loop (path) around a circuit, the sum of the emf's = the sum of the p.d.'s." **S**econd for **S**um.
Justify Kirchhoff's Second Law	Each charge carrier **must transfer all its energy** within the circuit and **return to the cell with none** remaining.
What is electromotive force (ε)?	The energy transferred (1) by the cell per unit charge (1).
What does an ideal voltmeter measure around a cell?	Terminal p.d.
What is a potential divider?	A circuit that uses **two or more resistors** in series to supply a **variable p.d**.
What fact is the potential divider based on and why? And what does this mean?	● **P.d. ∝ resistance** under constant current ∵ electrons **need more energy** to overcome the resistance. ● Meaning the resistor with **greater resistance** will have a **greater share of the p.d**.
What is equal in a potential divider circuit and why?	The **ratio of the voltages** to the **ratio of the resistances** because current is constant. $$\frac{V_{out}}{V_{in}} = \frac{R_{out}}{R_T}$$
Give a developed application of a potential divider	Temperature control. E.g., for the diagram below, if R_1 is a thermistor, when it gets colder, its resistance increases ⇒ the its p.d. (V_{out}) increases too which could then be used to turn on a heater. 

Why is measuring emf using an open/close switch and a voltmeter not ideal in reality?	There's still some current flowing through the circuit to power the voltmeter so by $\varepsilon = V + Ir$, $\varepsilon \neq V$. This current leads to the internal resistance having an effect. *Thus, it's better to measure emf indirectly. Yet, in an ideal physics world, where a voltmeter has infinite resistance, no current passes via the circuit so the internal resistance has no effect so the emf is displayed.*
How do e.m.f sources in opposite polarities work?	● Current will flow from the positive to negative terminal of the source with the largest emf. ● The source acting in opposite reduces the total emf.