ELECTRICITY SUMMARY NOTES

Voltage (potential difference) is the energy transferred to each coulomb of charge.

It is measured in volts (V). 1 V = 1 J per C

Current is the charge transferred per second.
It is measured in amps (A). 1A = 1 C per s

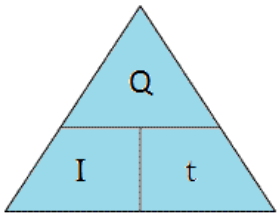
<u>Mains Voltage:</u> 230V, 50 Hz

Factors that <u>increase</u> <u>resistance</u>

Increase:
Temperature
Length of wire
Thickness of wire

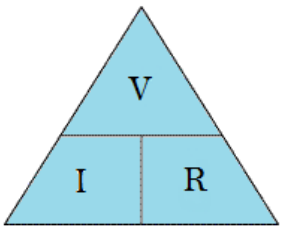
$$\text{charge} = \text{current} \times \text{time}$$

$$Q = It$$

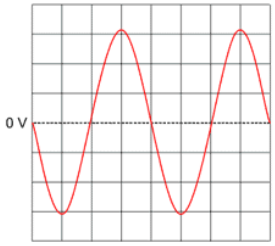


Voltage = Current x Resistance

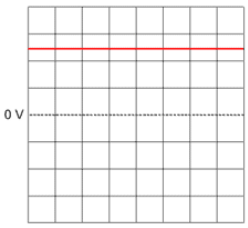
$$V = IR$$



<u>A.C. - alternating current</u>
- changes direction and magnitude
- from the mains

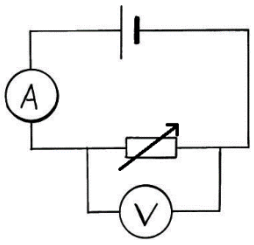


<u>D.C. - direct current</u> - one direction only
- from a battery
Same magnitude

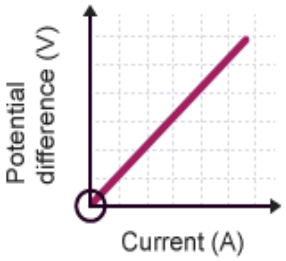


Ohms Law Experiment

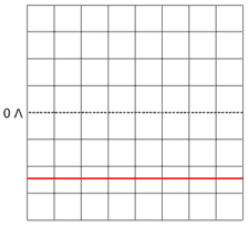
Adjust resistance of variable resistor and take readings of V & I



Ohms Law Graph



If the polarity of D.C. trace is reverse (the connections are swapped) the trace goes below the line by the same amount



Resistance opposes the flow of current (Ω)

Gradient,
m = V/ I = R

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Series Rules

$Is = I_1 = I_2 \ldots$

$Vs = V_1 + V_2 \ldots$

$R_T = R_1 + R_2 \ldots$

Adding R = R_T

Parallel Rules

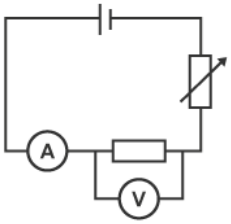
$Is = I_1 + I_2 \ldots$

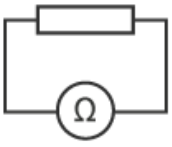
$Vs = V_1 = V_2 \ldots$

$1/R_T = 1/R_1 + 1/R_2 \ldots$

Connecting meters

Ammeters -> series
Voltmeters -> Parallel





Ohmmeters -> no power supply

Transistors are electronic switches

The input voltage controls the switch.

<u>npn transistor</u>
Input voltage must be <u>0.7V</u>

or above to switch on the output device.

<u>n channel enhancement MOSFET</u>
Input voltage must be <u>2V</u>
or above to switch on the output dev

Output Devices

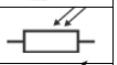
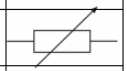
All the components below change electrical energy <u>into another form of energy</u>

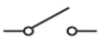
Light Emitting Diode (LED)	Electrical -> Light	
Solenoid	Electrical -> Kinetic	
Motor	Electrical -> Kinetic	

Buzzer	Electrical -> Sound	
Filament Lamp	Electrical -> Light	
Loudspeaker	Electrical -> Sound	
Relay	Electrical -> Kinetic	

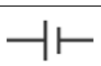
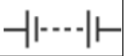
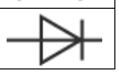
Input devices

All the components below change <u>another form of energy</u> <u>into</u> electrical energy

Thermistor	T. U. R. D.	
Light Dependant Resistor (LDR)	L. U. R. D.	
Variable Resistor	Resistance can be altered	
Capacitor	Stores charge and energy	

Switch	Completes/breaks circuits	
Microphone	Sound -> Electrical	
Thermocouple	Heat -> Electrical	
Solar Cell	Light -> Electrical	

Other components

Cell	Provides electrical energy to charges in a circuit	
Battery	Same as cell	
Diode	Allows current to flow in one direction only	

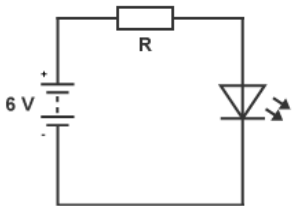
More about LEDs

Series resistor protects LED from high current

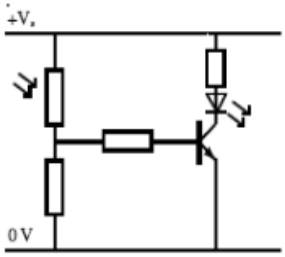
Current flows in opposite direction the arrow

<u>To calculate R:</u>

1. $V_R = V_S - V_{LED}$
2. Use $R = V_R / I$



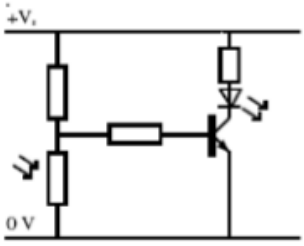
High Light sensor



Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON

Light ↑ R_{LDR} ↓ V_{LDR} ↓ V_R ↑

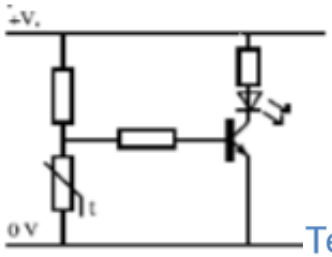
Low Light sensor



Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON

Light ↓ R_{LDR} ↑ V_{LDR} ↑

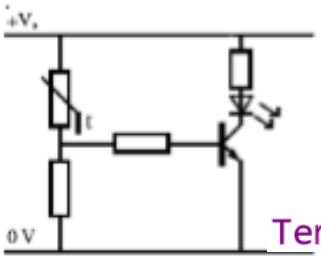
Switch on Low Temperature



Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON

Temp ↓ R_T ↑ V_T ↑

Switch on High Temperature



Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON

Temp ↑ R_T ↓ V_T ↓ V_R ↑

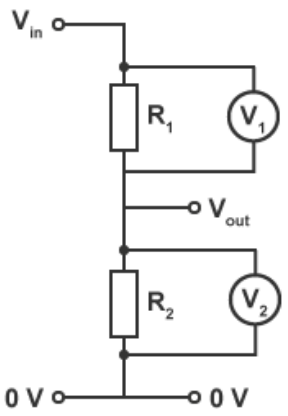
Voltage (potential) dividers

These divide a supply voltage between 2 resistors

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right) V_s$$

$$V_s = V_1 + V_2$$



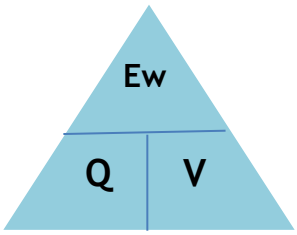
Power is the energy transferred per second

It is measured in Watts (W). 1W = 1 J per s

$$E_w = QV$$

Energy supplied to the charges

= Charge × voltage



A fuse melts to break the circuit if the current is too high.

Power rating less than 720W – 3A fuse

Power rating above 720W – 13A fuse

Some appliances with a power rating less that 720W require a 13A fuse as they have a high current on switch on.

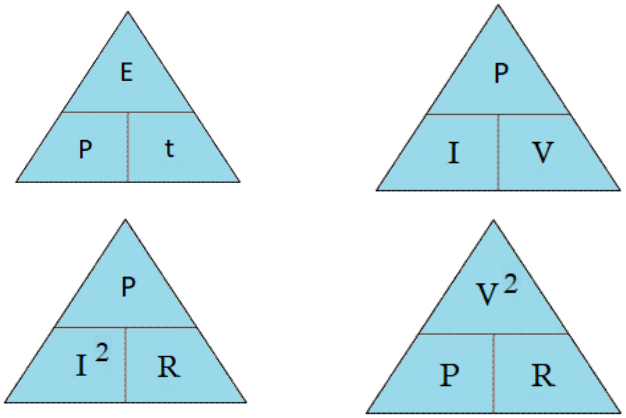
Power = Energy / Time

Power = current x voltage $P = IV$

Power = current ^{2} x resistance $P = I^2R$

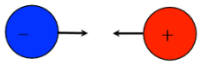
Power = voltage ^{2} /resistance $P = \frac{V^2}{R}$

Greater current/voltage = greater power developed

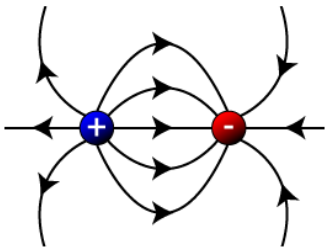


Charges and Electric fields

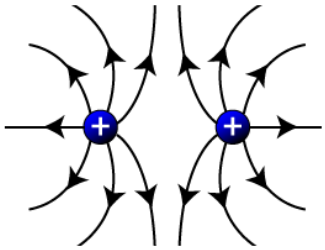
- Opposites ATTRACT

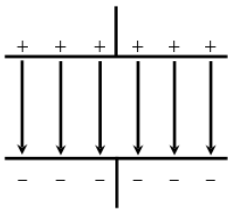


- Like/Similar REPEL



A charged particle experiences a force in an electric field





Capacitors store charge on their plates. Capacitance, C, is measured in **farads** (F). Capacitors can be used **with resistors in series as timing devices**.

The bigger the value of the resistance and the bigger the value of the capacitor, the longer it takes to charge to Vs