**ELECTRICITY SUMMARY NOTES**

| Voltage (potential difference) is the energy transferred to each coulomb of charge. | **Mains Voltage:** 230V, 50 Hz
| --- | --- |
| It is measured in volts (V). 1 V = 1 J per C | **Factors that increase resistance**
| Current is the charge transferred per second. It is measured in amps (A). 1A = 1 C per s | Increase:
| |
| **Temperature** | Temperature
| **Length of wire** | Length of wire
| **Thickness of wire** | Thickness of wire

\[
\text{charge} = \text{current} \times \text{time}
\]

\[
Q = It
\]

\[
\text{Voltage} = \text{Current x Resistance}
\]

\[
V = IR
\]

**A.C. - alternating current**
- changes direction and magnitude
- from the mains

\[
\begin{align*}
\text{A.C.} & \quad \text{-} \\
& \quad \text{D.C. - direct current}
\end{align*}
\]

- one direction only
- from a battery

**D.C. - direct current**
- Same magnitude

**Ohms Law**

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

**Ohms Law Graph**

\[
\text{Resistance opposes the flow of current (}\Omega\text{)}
\]

\[
m = \frac{V_2 - V_1}{I_2 - I_1} = R
\]

**Series Rules**

- \( I_s = I_1 = I_2 \ldots \)
- \( V_s = V_1 + V_2 \ldots \)
- \( R_T = R_1 + R_2 \ldots \)
- Adding \( R = R_T \)

**Parallel Rules**

- \( I_s = I_1 + I_2 \ldots \)
- \( V_s = V_1 = V_2 \ldots \)
- \( \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \ldots \)

**Connecting meters**

- Ammeters -> series
- Voltmeters -> Parallel
- Ohmmeters -> no power supply

**Transistors are electronic switches**

**npn transistor**
Input voltage must be 0.7V

or above to switch on the output device.

**n channel enhancement MOSFET**
Input voltage must be 2V
or above to switch on the output dev
**Output Devices**
All the components below change electrical energy into another form of energy

<table>
<thead>
<tr>
<th>Light Emitting Diode (LED)</th>
<th>Electrical -&gt; Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid</td>
<td>Electrical -&gt; Kinetic</td>
</tr>
<tr>
<td>Motor</td>
<td>Electrical -&gt; Kinetic</td>
</tr>
<tr>
<td>Buzzer</td>
<td>Electrical -&gt; Sound</td>
</tr>
<tr>
<td>Filament Lamp</td>
<td>Electrical -&gt; Light</td>
</tr>
<tr>
<td>Loudspeaker</td>
<td>Electrical -&gt; Sound</td>
</tr>
<tr>
<td>Relay</td>
<td>Electrical -&gt; Kinetic</td>
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</tbody>
</table>

**Input devices**
All the components below change another form of energy into electrical energy

<table>
<thead>
<tr>
<th>Thermistor</th>
<th>T. U. R. D.</th>
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<tbody>
<tr>
<td>Light Dependant Resistor (LDR)</td>
<td>L. U. R. D.</td>
</tr>
<tr>
<td>Variable Resistor</td>
<td>Resistance can be altered</td>
</tr>
<tr>
<td>Capacitor</td>
<td>Stores charge and energy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Switch</th>
<th>Completes/breaks circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone</td>
<td>Sound -&gt; Electrical</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>Heat -&gt; Electrical</td>
</tr>
<tr>
<td>Solar Cell</td>
<td>Light -&gt; Electrical</td>
</tr>
</tbody>
</table>

**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

To calculate R:
1. \( V_R = V_S - V_{LED} \)
2. Use \( R = \frac{V_R}{I} \)

**High Light sensor**
Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON

**Low Light sensor**
Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON

**Switch on Low Temperature**
Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON

**Switch on High Temperature**
Voltage across transistor increases above 0.7V, transistor switches ON LED switches ON
Voltage (potential) dividers
These divide a supply voltage between 2 resistors

\[ \frac{V_1}{V_2} = \frac{R_1}{R_2} \]

\[ V_2 = \left( \frac{R_2}{R_1 + R_2} \right) V_1 \]

\[ V_s = V_1 + V_2 \]

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
\[ = \text{Charge} \times \text{voltage} \]

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

**Power = Energy / Time**

**Power = current x voltage**  \[ P = IV \]

**Power = current \(^2\) x resistance**  \[ P = I^2 R \]

**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