**Electricity & Energy**

**Electrical & Electronic Components**

**Summary**

Cells and batteries convert stored chemical energy into electrical energy.

Cells produce low voltage d.c..

Batteries consist of two or more cells connected together.

Lamps (or bulbs) convert electrical energy into light.

Switches can make or break electrical circuits.

Ammeters are used to measure current.

Voltmeters are used to measure potential difference (voltage).

Resistors oppose the movement of charge (current).

Resistors have resistance, measured in ohms (Ω).

Variable resistors are used to change the resistance in a circuit.

The resistance of thermistors varies with temperature.

The resistance of light dependent resistors (LDRs) varies with light level.

lamp

battery

cell

voltmeter

ammeter

light dependent resistor (LDR)

t

thermistor

A

V

variable resistor

resistor

switch

*R*

*Vs*

Fuses are thin pieces of wire which melt and break if too large a current passes through them.

Fuses protect wiring from overheating.

Motors convert electrical energy into kinetic energy.

Loudspeakers convert electrical energy into sound.

Microphones convert sound into electrical energy

Relays are electrically operated switches.

Applying a low voltage to the coil of the relay closes (or opens) the switch.

Relays are used to allow low voltage electronic circuits to switch on and off higher power devices.

Photovoltaic (solar) cells convert light into electrical energy.

Diodes only allow current to pass in one direction.

Light emitting diodes (LEDs) convert electrical energy into light

LEDs only work when connected the right way round.

Resistors are connected in series with LEDs to prevent them being damaged by too large a current.

LEDs require a certain voltage *VLED* and current *ILED* to operate

$$V\_{R}=V\_{s}-V\_{LED}$$

$$I\_{R}=I\_{LED}$$

$$R=\frac{V\_{R}}{I\_{R}}$$

LEDs only require a small current to light and are more efficient than filament lamps.

loudspeaker

motor

fuse

+

-

diode

+

-

M

microphone

light emitting diode (LED)

photovoltaic cell

relay

voltage divider circuit

*V1*

*V2*

*R1*

*R2*

*Vs*

0

*Vs*

charging

R

C

*Vs*

capacitor

A voltage divider circuit is made up of of two (or more) resistors connected in series.

In a voltage divider circuit the supply voltage is shared (or divided) between the resistors.

The ratio of the voltages across the resistors in a voltage divider is the same as the ratio of their resistances:

$$\frac{V\_{1}}{V\_{2}}=\frac{R\_{1}}{R\_{2}}$$

The voltage across a resistor in a voltage divider can be calculated using:

$$V\_{2}=\frac{R\_{2}}{R\_{1}+R\_{2}}×V\_{s}$$

Capacitors store electrical charge.

The amount of charge a capacitor can store per volt across it is known as the capacitance the capacitor.

Capacitance is measured in farads (F).

When connected in series with a resistor a capacitor takes time to charge and discharge.

Increasing the capacitance of the capacitor increases the time taken to charge/discharge.

Increasing the resistance of the resistor increases the time taken to charge/discharge.

Transistors can be used as electronic switches.

A bipolar junction transistor will conduct between its emitter and collector when the base-emitter voltage is above a certain value.

e.g. Low temperature sensor

* temperature decreases
* resistance of thermistor increases
* voltage across thermistor increases
* voltage at transistor base reaches a certain value
* transistor switches on
* LED lights

A MOSFET transistor will conduct between its source and drain when the gate-source voltage is above a certain value

e.g. High light level sensor

* light level increases
* resistance of LDR decreases
* voltage across LDR decreases
* voltage at transistor gate increases
* voltage at transistor gate reaches a certain value
* transistor switches on
* LED lights

*+Vs*

0V

*+Vs*

0V

t

gate

source

drain

MOSFET transistor

bipolar junction transistor

base

collector

emitter