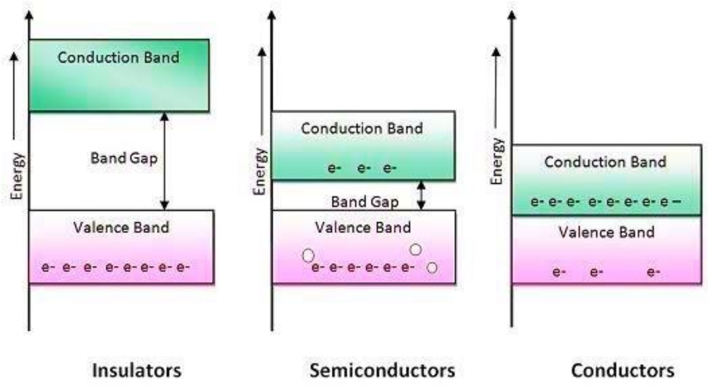
# Characteristic curve of diode experiment

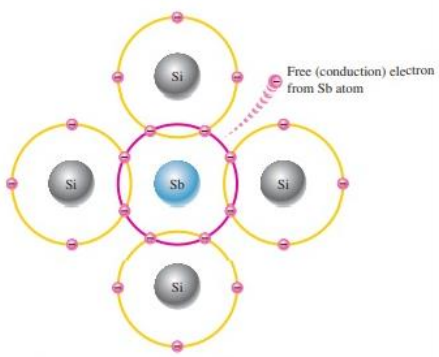
Aim: To draw the characteristic curve of a Zener and PN junction diode.

Theory: Semiconductor substances are such material which has conductivity properties among conductors and insulators. Their conductance is restricted due to the least number of free electrons and holes in the valence band. A pure semiconductor material is mixed or doped with other materials to create free electrons and holes for conduction.



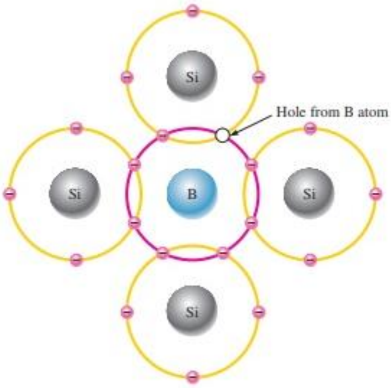

**N-type Semiconductor**

- Pentavalent impurity atoms are added – Arsenic (As), phosphorus (P),bismuth (Bi),
- Pentavalent also known as a donor atoms since they donate electrons. When a pentavalent atom is added to an intrinsic semiconductor, it'll readily donate it's $5^{th}$ electron, as a result – becomes n-type extrinsic semiconductor.
- In n-type material electrons are majority carrier, and holes the minority carrier.




**p-type semiconductor**

- Trivalent (with 3 valence electrons) impurity atoms are added – Aluminum (Al), boron (B), indium (In), gallium (Ga)
- Trivalent also known as an acceptor atom since they accept electrons. When a trivalent atom is added to an intrinsic semiconductor, it'll readily accept free electron, as a result – becomes p-type extrinsic semiconductor.
- In p-type material holes are majority carrier, and electron the minority carrier




**Diodes**

A diode is defined as a two-terminal electronic component that only conducts current in one direction (so long as it is operated within a specified voltage level). An ideal diode will have zero resistance in one direction, and infinite resistance in the reverse direction.

Although in the real world, diodes cannot achieve zero or infinite resistance. Instead, a diode will have negligible resistance in one direction (to allow current flow), and very high resistance in the reverse direction (to prevent current flow). A diode is effectively like a valve for an electrical circuit.

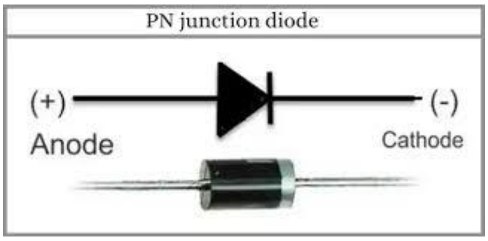
Semiconductor diodes are the most common type of diode. These diodes begin conducting electricity only if a certain threshold voltage is present in the forward direction (i.e., the "low resistance" direction).

- The diode is said to be "forward biased" when conducting current in this direction.
- When connected within a circuit in the reverse direction (i.e., the "high resistance" direction), the diode is said to be "reverse biased".

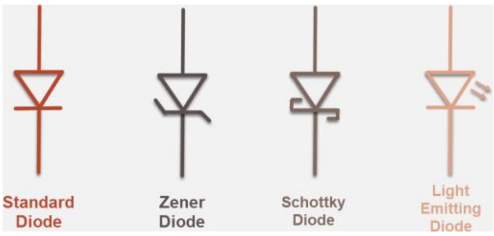
A diode only blocks current in the reverse direction (i.e., when it is reverse biased) while the reverse voltage is within a specified range. Above this range, the reverse barrier breaks. The voltage at which this breakdown occurs is called the "reverse breakdown voltage".

When the voltage of the circuit is higher than the reverse breakdown voltage, the diode is able to conduct electricity in the reverse direction (i.e., the "high resistance" direction). This is why in practice we say diodes have a high resistance in the reverse direction – not an infinite resistance.

A PN junction is the simplest form of the semiconductor diode. In ideal conditions, this PN junction behaves as a short circuit when it is forward biased, and as an open circuit when it is in the reverse biased. The name diode is derived from "di–ode" which means a device that has two electrodes. Diodes are commonly used in many electronics projects and are included in many of the best Arduino starter kits.

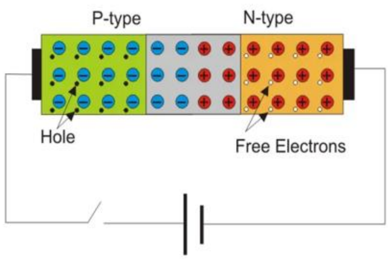


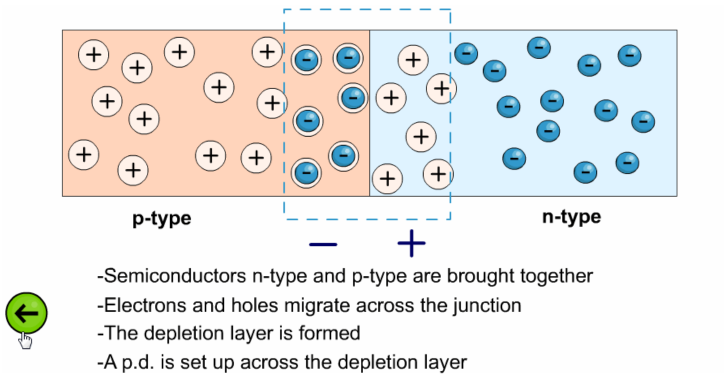
The symbol of a diode is shown below. The arrowhead points in the direction of conventional current flow in the forward biased condition. That means the anode is connected to the p side and the cathode is connected to the n side.

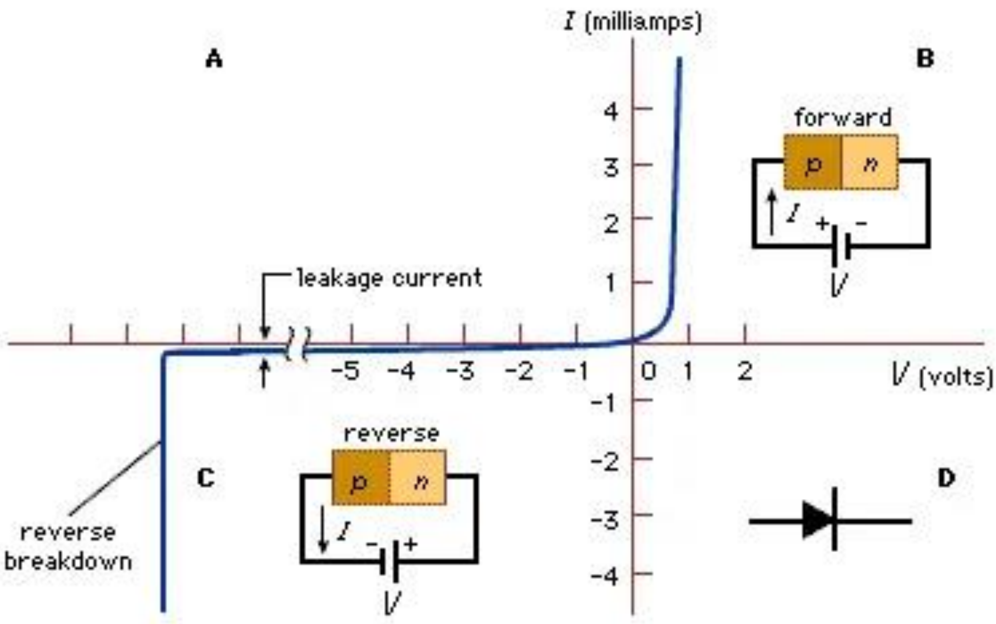



**Working Principle of Diode**

A diode's working principle depends on the interaction of n-type and p-type semiconductors. An n-type semiconductor has plenty of free electrons and a very few numbers of holes. In other words, we can say that the concentration of free electrons is high and that of holes is very low in an n-type semiconductor.

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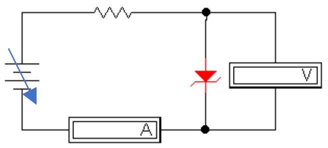
Apparatus:

1. DC power supply.
2. Voltammeter.
3. Ammeter.
4. Resistance.
5. Diodes (Zener and PN junction)

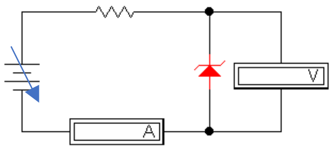
Method:

1. Connect the diode in the forward bias mode.
2. Connect a current limiting resistor in series with the diode.
3. Slowly increase the voltage applied, and measure the current (I) through the diode and the voltage across the diode (VD). Take more than 10 readings.
4. Use the forward bias data for the diode and plot an VD vs ID graph.
5. From this graph, calculate the forward resistance by calculation the slope of the curve in the ON region.
6. Repeat the above step in the reverse bias.

Result:




***Forward Biased***




**Reversed Biased**

For Zener Diode

***Forward Biased***

| Voltage (volt) | Current(mA) |
|---|---|
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***Reverse Biased***

| Voltage (volt) | Current(mA) |
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For PN junction Diode

***Forward Biased***

| Voltage (volt) | Current(mA) |
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***Reversed Biased***

| Voltage (volt) | Current(mA) |
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