AIM

To draw *I* - *V* characteristic curves of a p-n junction in forward bias and reverse bias.

APPARATUS AND MATERIAL REQUIRED

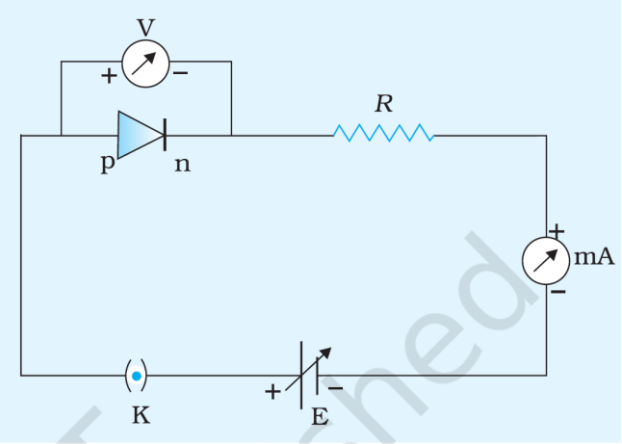
A p-n junction diode(1N4007), a resistor, one variable voltage power supply, voltmeter, milli-ammeter, a micro-ammeter, connecting wires

PRINCIPLE

1. ***Forward bias*:** When an external voltage is applied to a p-n junction diode in such a way that the p-side is at a higher potential with respect to the n-side, it is said to be forward biased.
2. ***Threshold voltage or "Cut-in" voltage*:** When the p-side is connected to the positive terminal of the battery and the voltage is increased, initially a negligible current flows till the applied voltage crosses a certain value. After, a characteristic voltage, the diode current increases significantly (exponentially), even for a very small increase in the diode bias voltage. This voltage is called the threshold voltage or cut-in-voltage of the diode.
3. ***Reverse bias*:** In reverse bias, the p-side of the p-n junction diode is connected to the negative of the battery.
4. ***Reverse saturation current*:** As the applied voltage is increased in the reverse biased condition, starting from zero value, the current increases, but soon becomes constant. This current is very small (a few microamperes). It is called the reverse saturation current.

PROCEDURE

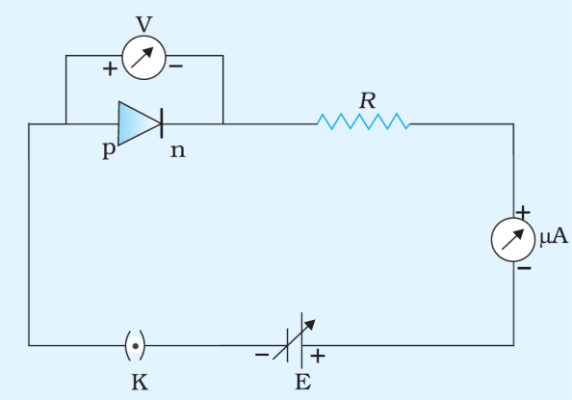
1. Note the range and least count of the given voltmeter (V), milliammeter (mA) and the microammeter (μA).
2. Connect the variable voltage power supply, p-n junction diode, voltmeter, milliammeter, resistor and a plug key in a circuit as shown in Fig. 1.
3. Give a small voltage to the circuit by slight and gentle turning of the power supply knob. Note the voltmeter reading across the diode and the corresponding milli-ammeter reading to find the current I flowing through the diode.
4. Gradually, increase the applied voltage (in steps) in the circuit and note the corresponding voltmeter and milli-ammeter readings in Table 1.



The value of current flowing through the diode would be negligibly small till the voltage across the diode exceeds the value of its *threshold voltage*. After the Threshold *voltage*, the variation in current will be rapid.

5. Once the threshold voltage is reached, vary the diode voltage very slowly (preferably in steps of 0.1V) noting the corresponding current *I* flowing through the diode. Continue increasing voltage till the current reaches the limit of the milliammeter.
6. Now disconnect the circuit and make the connections as shown in Fig. 2 for the reverse bias characteristics.

Connect p-side of p-n junction diode to the negative terminal of the power supply and replace milliameter with a microammeter. Gradually, increase the applied voltage (in steps) in the circuit and note the corresponding voltmeter and microammeter readings in Table 2. In this part of experiment, with the given supply voltage you will get only flat portion of the reverse bias characteristic curve.



Link: https://youtu.be/6Ha-ePYMyfM

OBSERVATIONS

1. For forward biasing
   (i) Range of voltmeter = ……
   (ii) Least count of voltmeter scale = ……V
   (iii) Range of milliammeter = ……
   (iv) Least count of milliammeter scale = ……mA

Table 1 : Variation of forward current with voltage across the diode (forward bias)

S.No.	Forward Voltage V_f (V)	Forward Current I_f (mA)
1		
2		
3		
-		
20		

2. For reverse biasing

   (i) Range of voltmeter = ……

   (ii) Least count of voltmeter scale = ……V

   (iii) Range of microammeter = ……

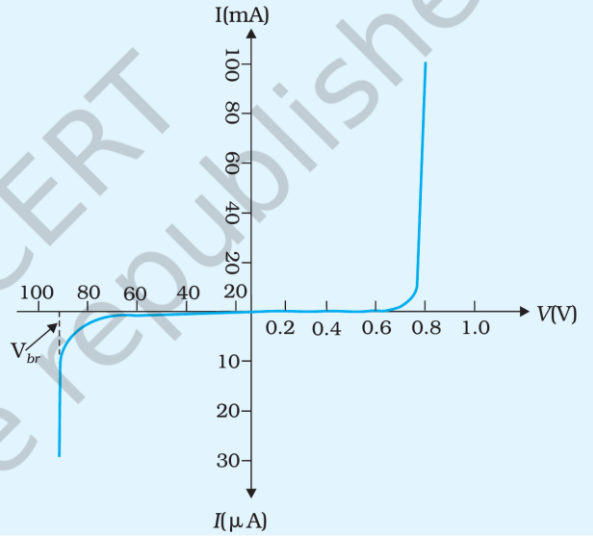
   (iv) Least count of microammeter scale = ……µA

Table 2: Variation of reverse current with voltage across the diode (reverse bias)

S.No.	Forward Voltage V_r (V)	Forward Current I_r (µA)
1		
2		
3		
-		
20		

CALCULATIONS/GRAPH

1. Plot a graph between forward voltage across the diode (V_f) along the positive x-axis and current flowing through the diode (I) along the positive y-axis. The graph as shown in Fig.3 represents a typical *I-V* characteristic of a silicon diode used. Locate the knee and determine the cut-in voltage.
2. Now plot the reverse voltage (V_r) along the negative x-axis and the corresponding current (in µA) along the negative y-axis as shown in Fig.3. Determine the reverse saturation current.



RESULT

A. The value of cut-in voltage for the given diode is ... V.

B. The reverse saturation current for the given diode is ... μA.

PRECAUTIONS

1. Find out manufacturer's specification for maximum permissible current through the given diode in forward bias. Take care not to exceed this limit.
2. Find out manufacturers specification for maximum reverse voltage to be applied to the diode. Take care not to exceed this limit.
3. It is important to take care that the potential difference across the diode is increased gradually, in small steps. Keep your eyes on the ammeter and let the current not exceed the specified limit.