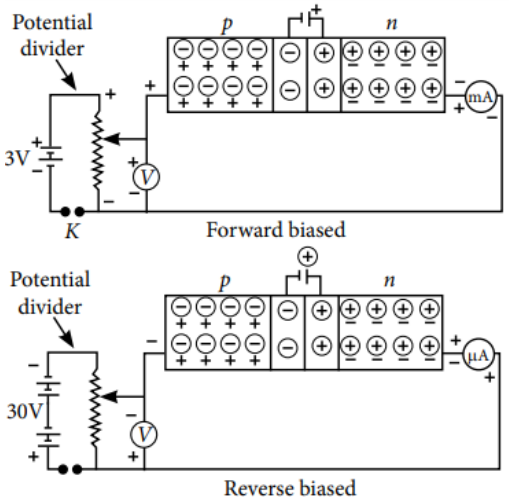
Experiment - 16 : To draw the characteristic curve of a p-n junction diode in forward and reverse bias.

Apparatus Required

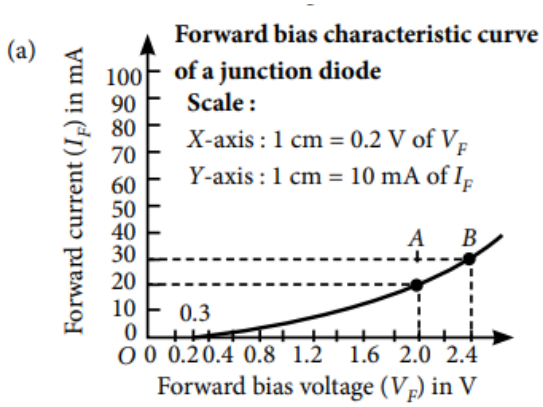
A p-n junction (semi-conductor) diode, a 30 volt and a 3 volt battery, a high resistance rheostat, one 0-3 volt voltmeter, one 0-30 volt voltmeter, one 0-100 mA ammeter, one 0-100 μA ammeter, one way key, connecting wires and pieces of sand paper.

Circuit Diagram



Theory

Forward-bias on junction : It produces forward current. With increase in bias voltage, the forward current increases slowly in the beginning and then rapidly. At about 2.4 V, the current increases suddenly. The bias is at once made zero to avoid damage to the diode.

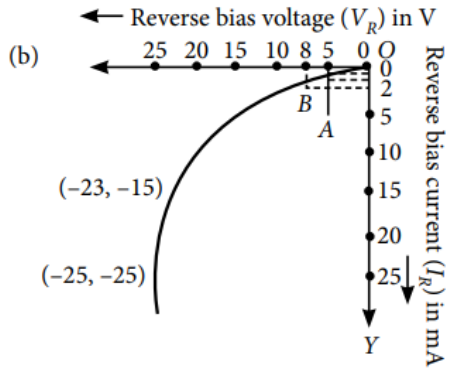


Reverse-bias on junction : In the beginning no appreciable reverse current flows. At about 5 V, a feeble current starts flowing. With increase in bias voltage, the current slowly increases. At about 25 V, the reverse current increase suddenly. Again, the bias is made zero to avoid damage.

Calculations

For forward-bias : Plot a graph between forward-bias voltage V_F and forward current I_F taking V_F along X-axis and I_F along Y-axis. A sample graph is shown below. This graph is called forward bias characteristic curve of a junction diode.

For reverse-bias : Plot a graph between reverse-bias voltage V_R and reverse current I_R taking V_R along X-axis and I_R along Y-axis. A sample graph is shown below. This graph is called reverse-bias characteristic curve of a junction diode.



In figure (a), For change from point A to B

$\Delta V_F = 2.4 - 2.0 = 0.4$ V, $\Delta I_F = 30 - 20 = 10$ mA

Hence junction resistance for forward-bias,

$$r = \frac{\Delta V_F}{\Delta I_F} = \frac{0.4 \text{ V}}{10 \text{ mA}} = 40 \text{ ohm}$$

In figure (b). For change from point A to B

$\Delta V_R = 8.0 - 5.0 = 3$V, $\Delta I_R = 2 - 1 = 1$ μA

Hence junction resistance for reverse-bias, $r = \frac{\Delta V_F}{\Delta I_F}$

$$= \frac{3\text{V}}{1\,\mu\text{A}} = 3 \times 10^6 \text{ ohm.}$$

MCQs Corner

Experiment – 16

72. When a P-N junction diode is reverse biased

(a) electrons and holes are attracted towards each other and move towards the depletion region.

(b) electrons and holes move away from the junction depletion region

(c) height of the potential barriers decreases

(d) no change in the current takes place.

73. In a P-N junction, there is no appreciable current if

(a) P-section is made positive and N-section negative

(b) a potential difference is applied across junction making P section negative and N-section positive

(c) a potential difference is applied across the junction

(d) it is impossible.

74. A P-N junction is said to be forward biased, when

(a) no potential difference is applied across P and N regions

(b) a potential difference is applied across P and N regions making P region positive and N region negative

(c) a potential difference is applied across P and N regions making P region negative and N region positive.

(d) a magnetic field is applied in the region of junction.

75. When P-N junction diode is forward biased, then

(a) the depletion region is reduced and barrier height is increased

(b) the depletion region is widened and barrier height is reduced

(c) both the depletion region and barrier height are reduced

(d) both the depletion region and barrier height are increased.

Answer Key

72. (b) 73. (b) 74. (b) 75. (c)

Hints & Explanation

72. (b) **73. (b)**

74. (b) : A forward biased conductor take place when the *p*-type is connected to the +ve terminal and *n*-type is connected to the –ve terminal of the battery.

75. (c)