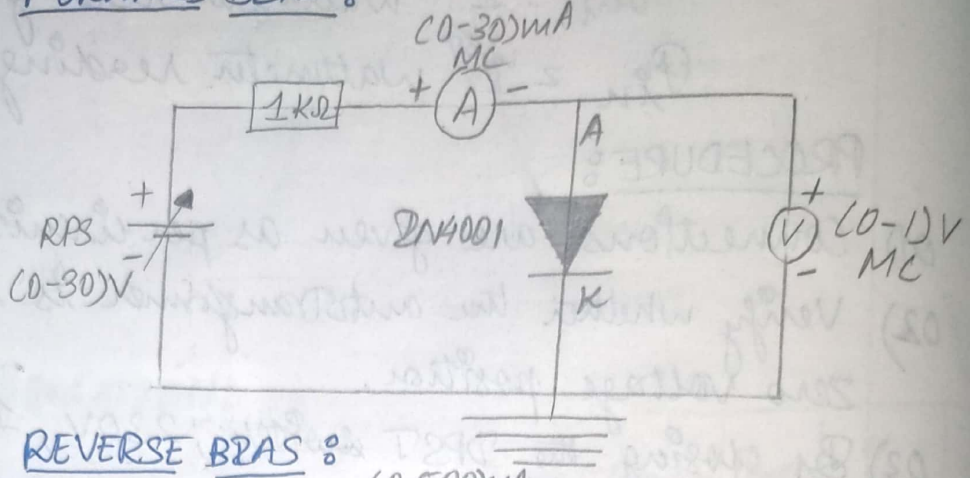
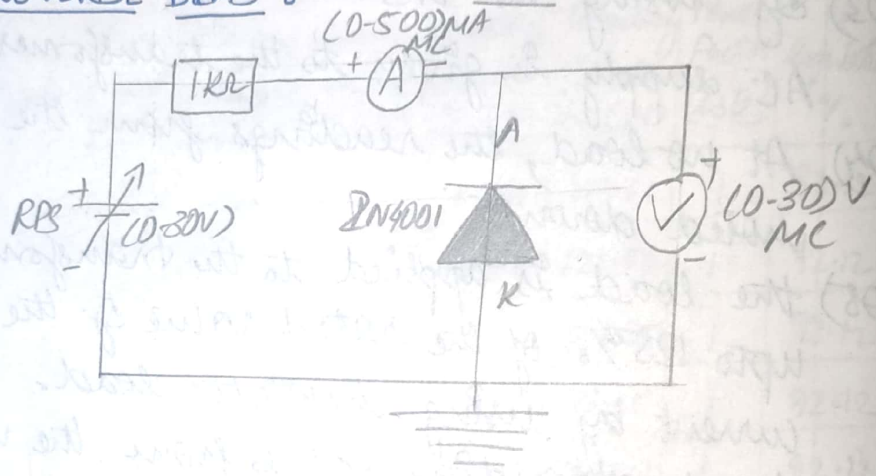
CIRCUIT DIAGRAM:

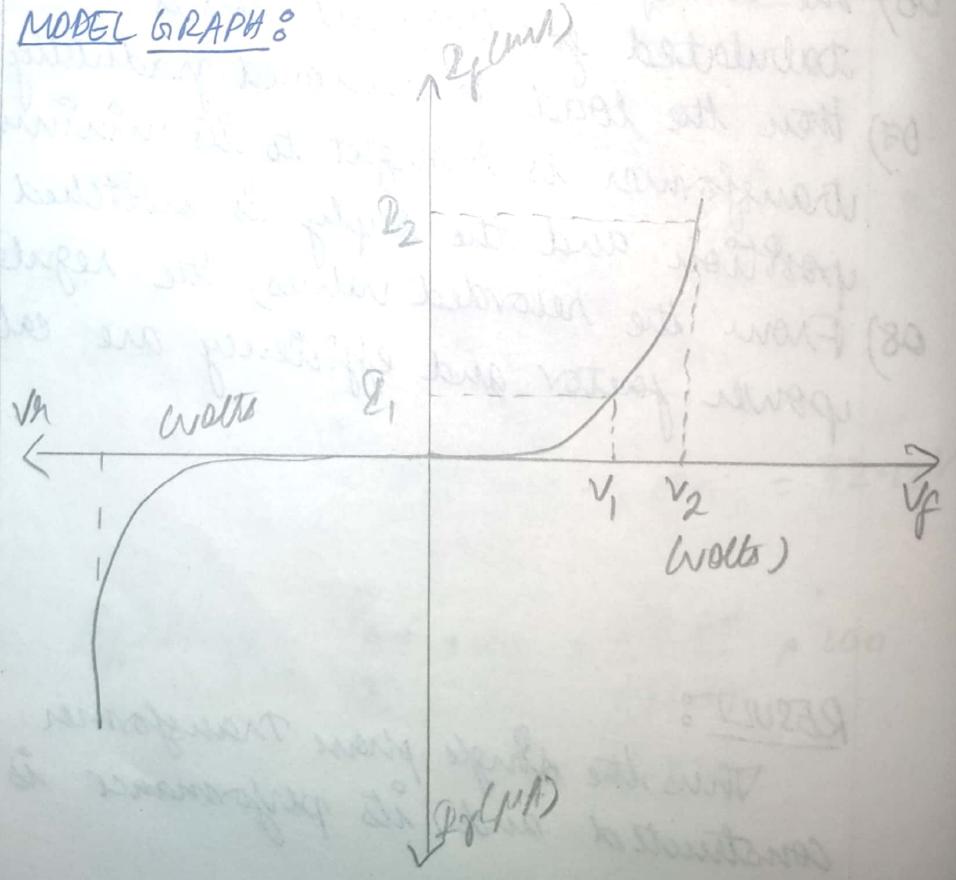
FORWARD BIAS:



REVERSE BIAS:



MODEL GRAPH:



Expt 05

CHARACTERISTICS OF PN JUNCTION DIODE

AIM:

To study the characteristics of PN function diode under forward and reverse bias condition.

APPARATUS REQUIRED:

S.No	Name	Range	Qty
1)	R.P.S	(0-30)V	1
2)	Ammeter	(0-30)mA	1
		(0-500)μA	1
3)	Voltmeter (V)	(0-1)V	1
		(0-10)V	1

COMPONENTS REQUIRED:

S.No	Name	Range	Qty
1)	Diode	IN4001	1
2)	Resistor	1KΩ	1
3)	Bread Board	-	1
4)	Connecting wire	-	Req.

THEORY: (Only on forward biasing)

A PN junction diode is a two terminal semi-conducting device. It conducts only in one direction.

FORWARD BIAS:

On forwardbiasing, initially no current flows due to barrier potential. As the applied potential exceeds the barrier and hence enter the other region. The holes, which are majority carriers in P-region, become minority carriers on entering the P-region. This injection of minority carriers results in the current flow, opposite to the direction of electron movement.

TABULAR COLUMN:

FORWARD BIAS

S.No	Forward voltage (Vf)	Forward current (If)
01)	0.1	0
02)	0.2	0
03)	0.3	0
04)	0.4	0.1
05)	0.5	0.7
06)	0.6	3.2
07)	0.7	9.6
08)	0.8	18.6
09)	0.9	26.5
10)	1.0	37.5
11)	1.1	47.6
12)	1.2	59.9
13)	1.3	70.6
14)	1.4	83.0
15)	1.5	97.0

REVERSE BIAS:

On reverse biasing, the majority charge carrier are attracted towards the terminals due to the applied potential resulting in the widening of the depletion region. Since the charge carriers are pushed towards the terminals no current flows in the device due to majority charge carriers. there will be some current in the device due to the thermally generated minority carriers. the generation of such carriers is independent of the applied potential and hence the current is constant for all increasing reverse potential. this current is refered to as Reverse saturation current (I_0) & it increases with temperature. when the applied reverse voltage is increased beyond the certain limit, it results in breakdown. During breakdown, the diode current increases tremendously.

PROCEDURE:

FORWARD BIAS

1) Connect the circuit as per the diagram.
2) Vary the applied voltage V in steps of 0.1 V.
3) Note down the corresponding ammeter reading I.
4) Plot a graph between V & I.

REVERSE BIAS

1) Find the d.c (static) resistance = V/I
2) Connect the circuit as per the diagram.
3) Vary the applied voltage V in steps of 1 V.
4) Note down the corresponding ammeter reading I.
5) Plot a graph between V and I.
6) Find the dynamic resistance $r = \delta V / \delta I$

Reverse Bias

S.No	Reverse Voltage (V_R)	Reverse Current (I_R)
01)	-1	-16.3
02)	-2	-20.9
03)	-3	-30.2
04)	-4	-41.0
05)	-5	-51.0
06)	-6	-60.6
07)	-7	-70.8
08)	-8	-80.5
09)	-9	-90.8
10)	-10	-101.4

Formula for Reverse Saturation current (I_0)

$$I = I_0\left[e^{V/\eta V_T} - 1\right] \text{ Amp}$$

Where

$I \rightarrow$ forward / Reverse diode current.

$I_0 \rightarrow$ reverse saturation current.

$V \rightarrow$ external voltage (+ve for forward, -ve for reverse bias)

$\eta \rightarrow$ constant number (1 for silicon, 2 for Germanium)

$V_T \rightarrow$ volt equivalent for temperature ($T/11600$)

$T \rightarrow$ temperature in kelvin.

SPECIFICATION FOR 1N4001 : silicon diode

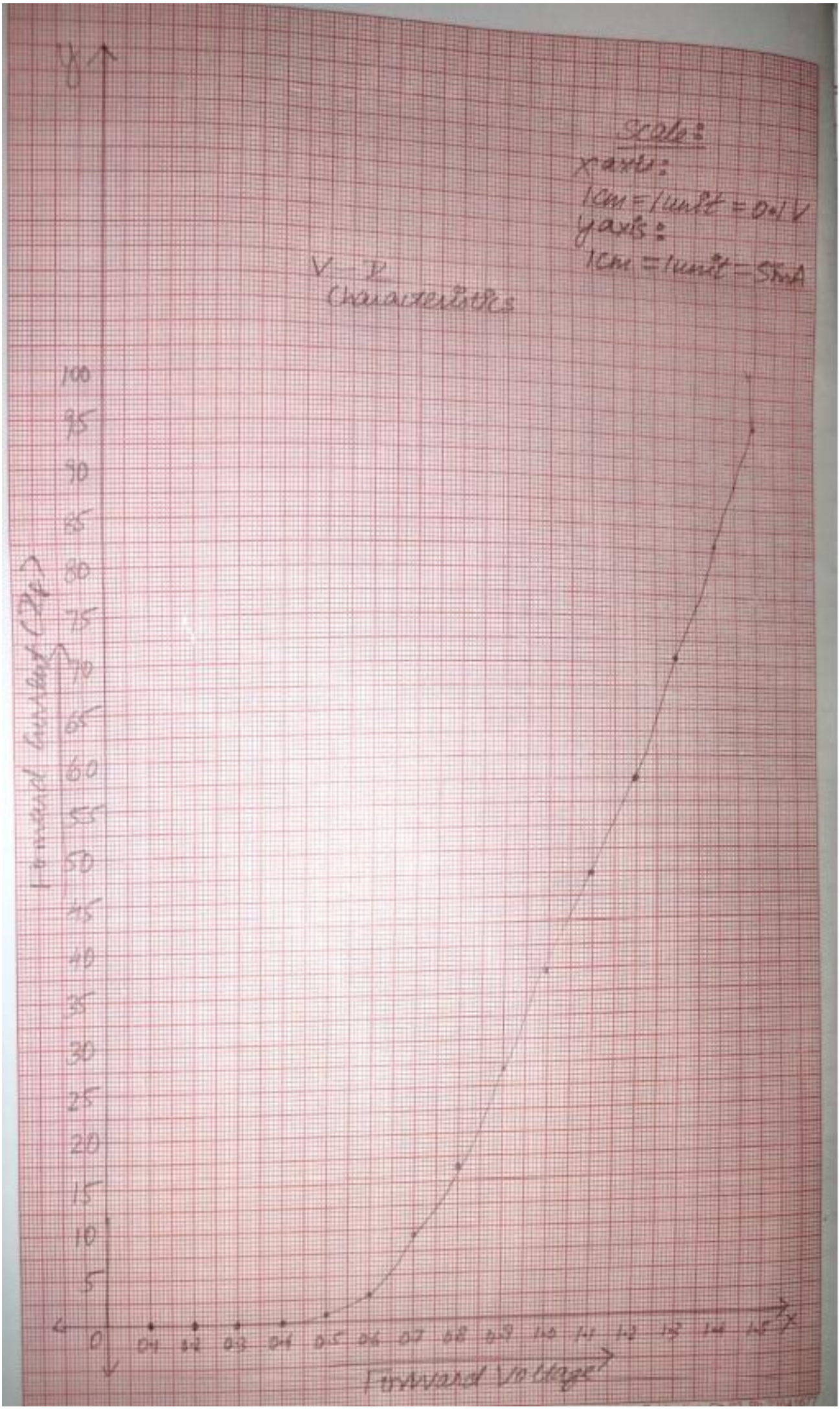
Peak Inverse voltage : 50 V

$I_{dc} = 1A$

* Maximum forward voltage drop at 1Amp is 1.1 volt.
* Maximum reverse current at 50 volts is 5μA.

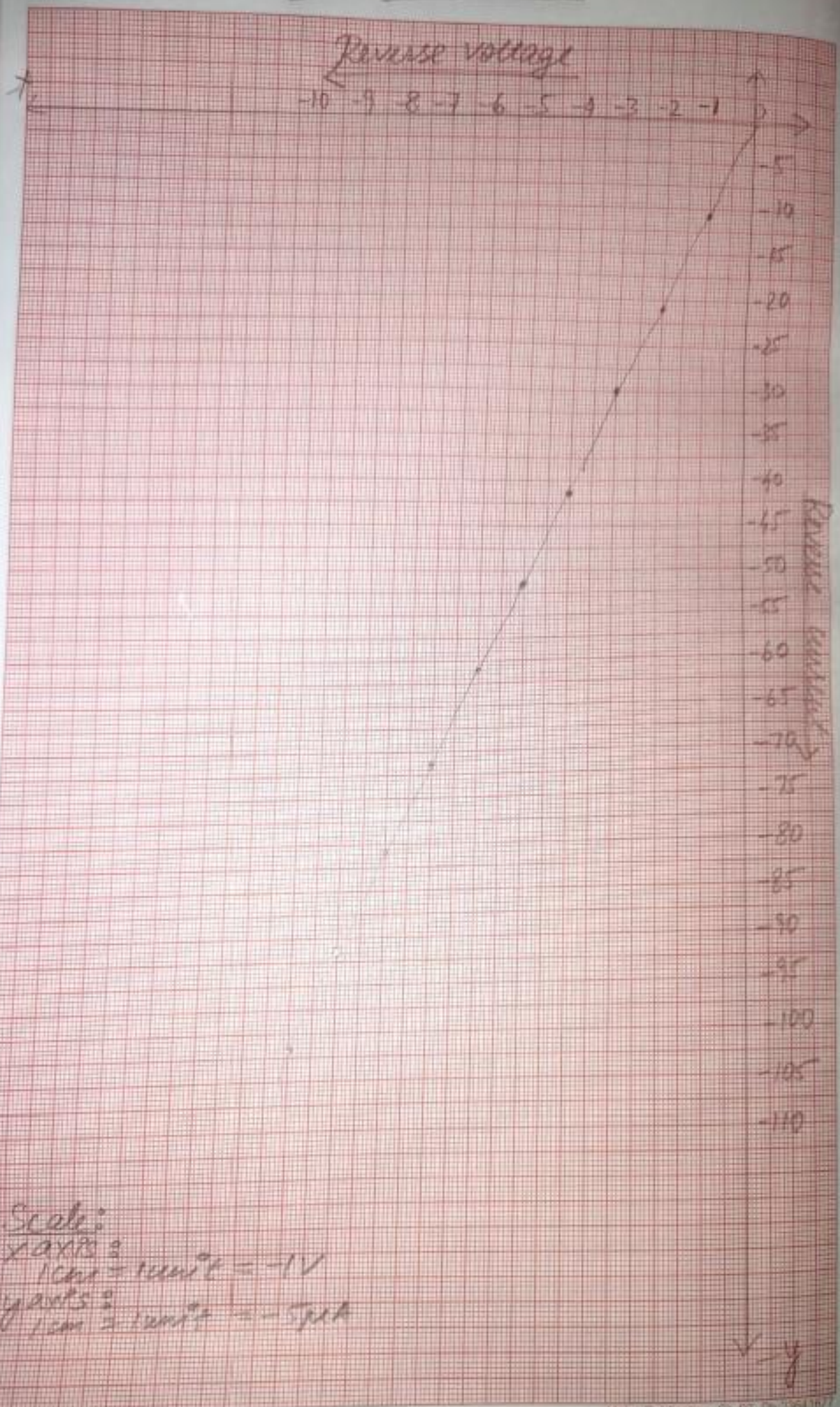
RESULT :

Thus the VI characteristics of a PN - Junction diode studied.


Y
Scale:
x axis:
1cm = 1unit = 0.1 V
y axis:
1cm = 1unit = 5mA
V I
Characteristics
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Forward current (mA)
Forward Voltage
X

(11)

I–V characteristics



Scale:

x axis:
1 cm = 1 unit = −1 V

y axis:
1 cm = 1 unit = −5 μA