Lab Report 4.1

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Title of Experiment: Objective 3.1 : I-V characteristics of a diode.

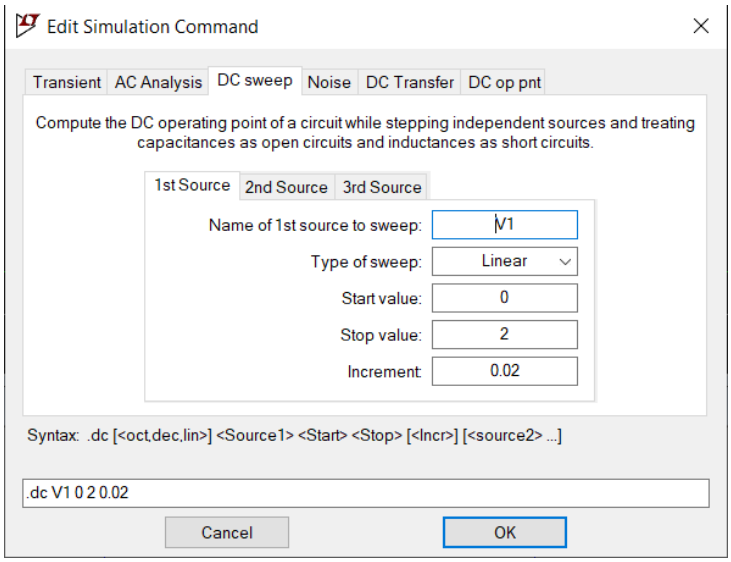
Brief Description: In this experiment, we simulated a circuit in LTSpice to depict the I-V characteristics of a P-N Junction diode. A junction diode is basically a semiconductor PN junction made of p-type and n-type semiconducting regions.
An ideal diode is a perfect conductor for one direction of current whereas a perfect insulator for the opposite direction. However, in practice the diode does not behave as ideal conductor or insulator in any case. Diode is a unidirectional passive device and thus polarity of the power supply connected to a diode is an important factor that we need to consider especially for design and experimentation.

Schematic diagram:

We use a DC sweep set-up in linear mode and make observations regarding the resulting I-V waveforms across the diode.

To change the settings of the X-axis, we write V(n001)-V(n002) which is the voltage across the Diode.

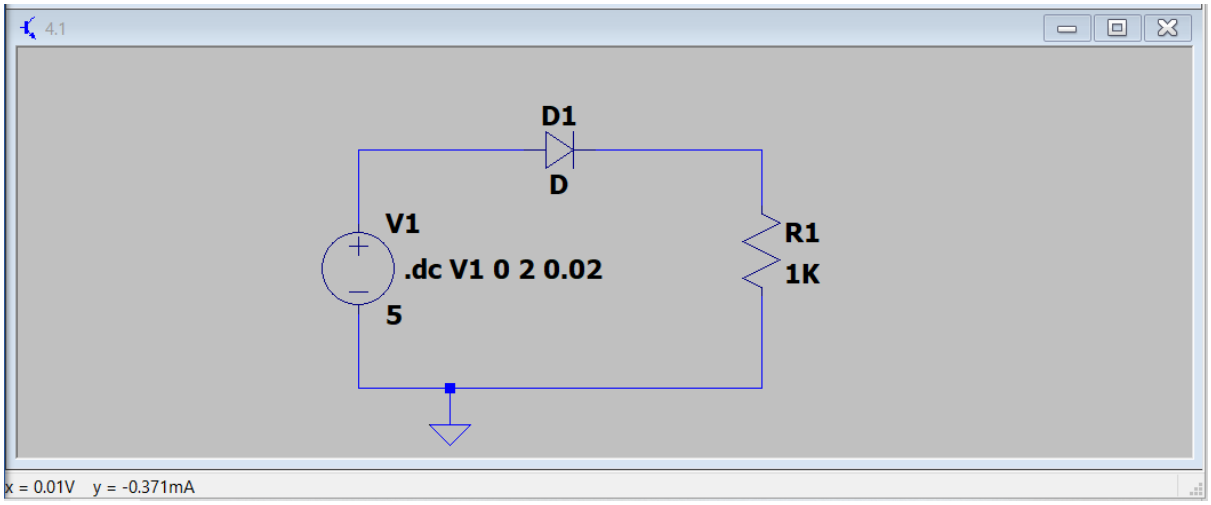
We record both the Current across the diode and the Knee voltage



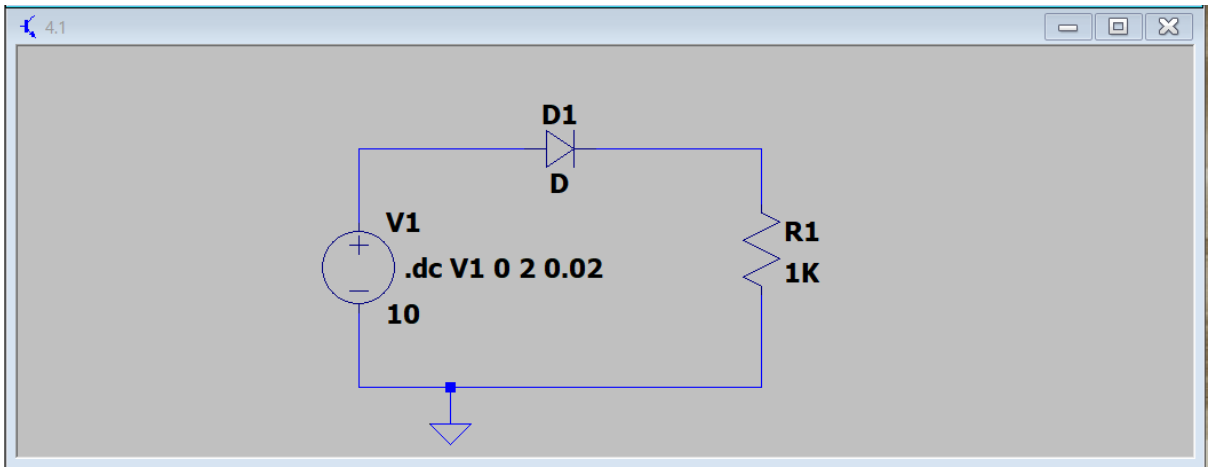
We use a DC sweep set-up in linear mode and make observations regarding the resulting I-V waveforms across the diode. We change the increment voltage 4 times to make eventful observations.
To change the settings of the X-axis, we write V(n001)-V(n002) which is the voltage across the Diode.

Following are the set-ups we considered:

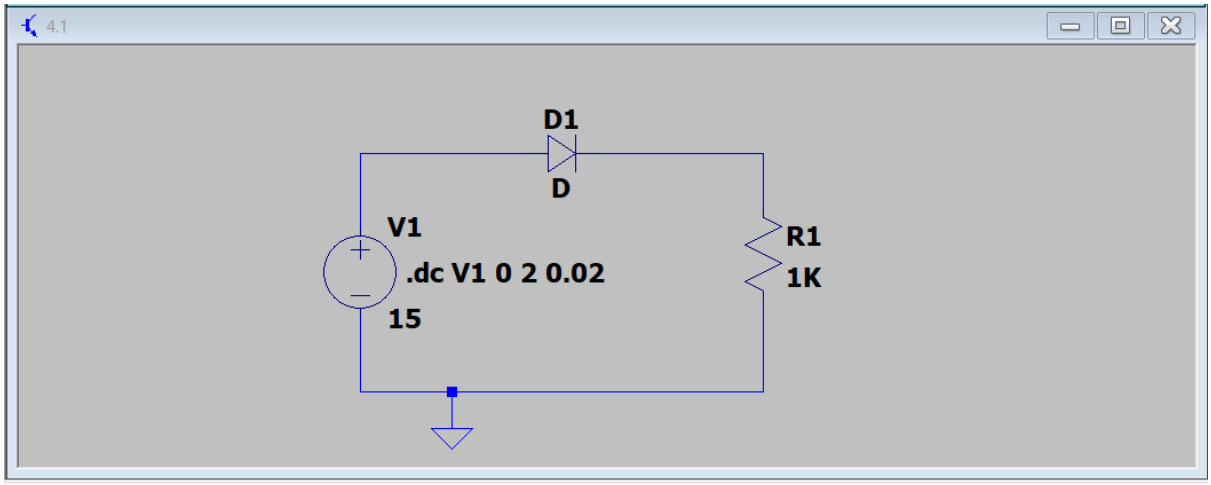
Case 1: 5V



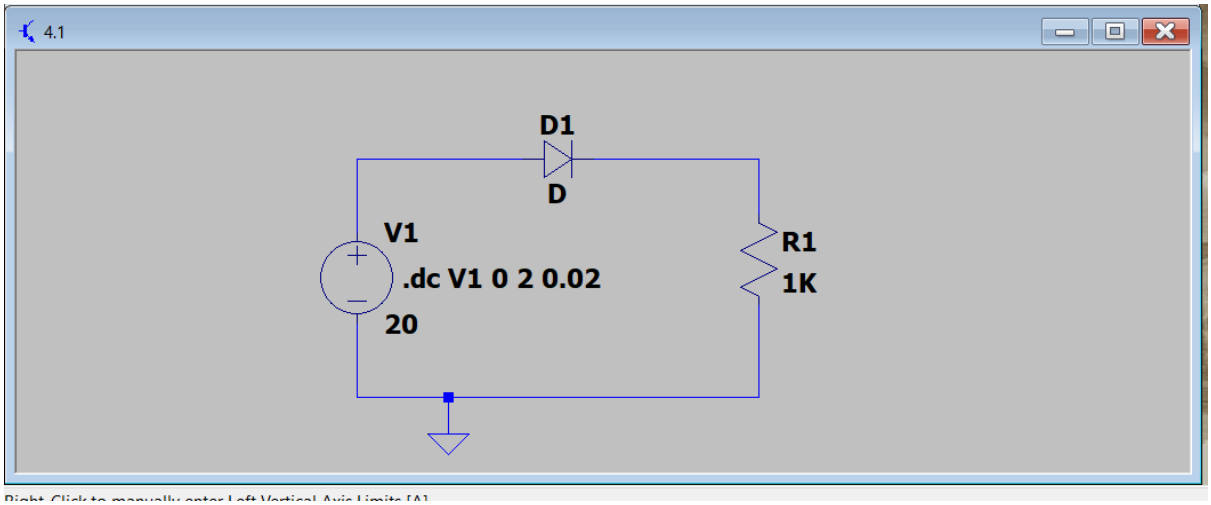
Case 2: 10V



Case 3: 15V



Case 4: 20V



Results:

S.No	Supply Voltage (in V)	Diode Current (in mA)	Knee Voltage (in V)
1	5	1.328	0.66
2	10	1.332	0.67
3	15	1.324	0.66
4	20	1.326	0.66

Calculations:

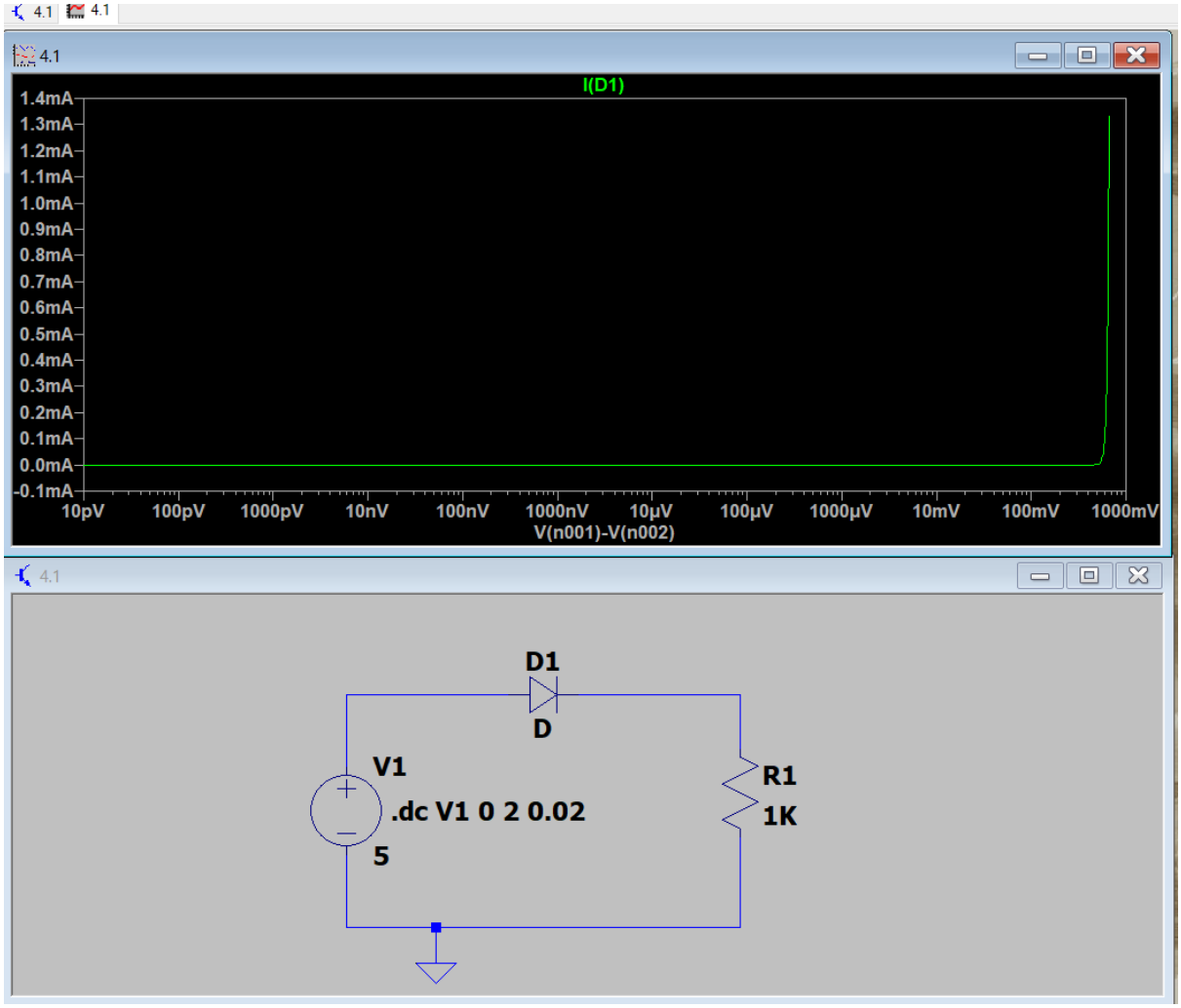
Knee Voltage of the Diode = Average of the Knee voltages obtained in the above table

= (0.66+ 0.67 + 0.66 + 0.66) / 4

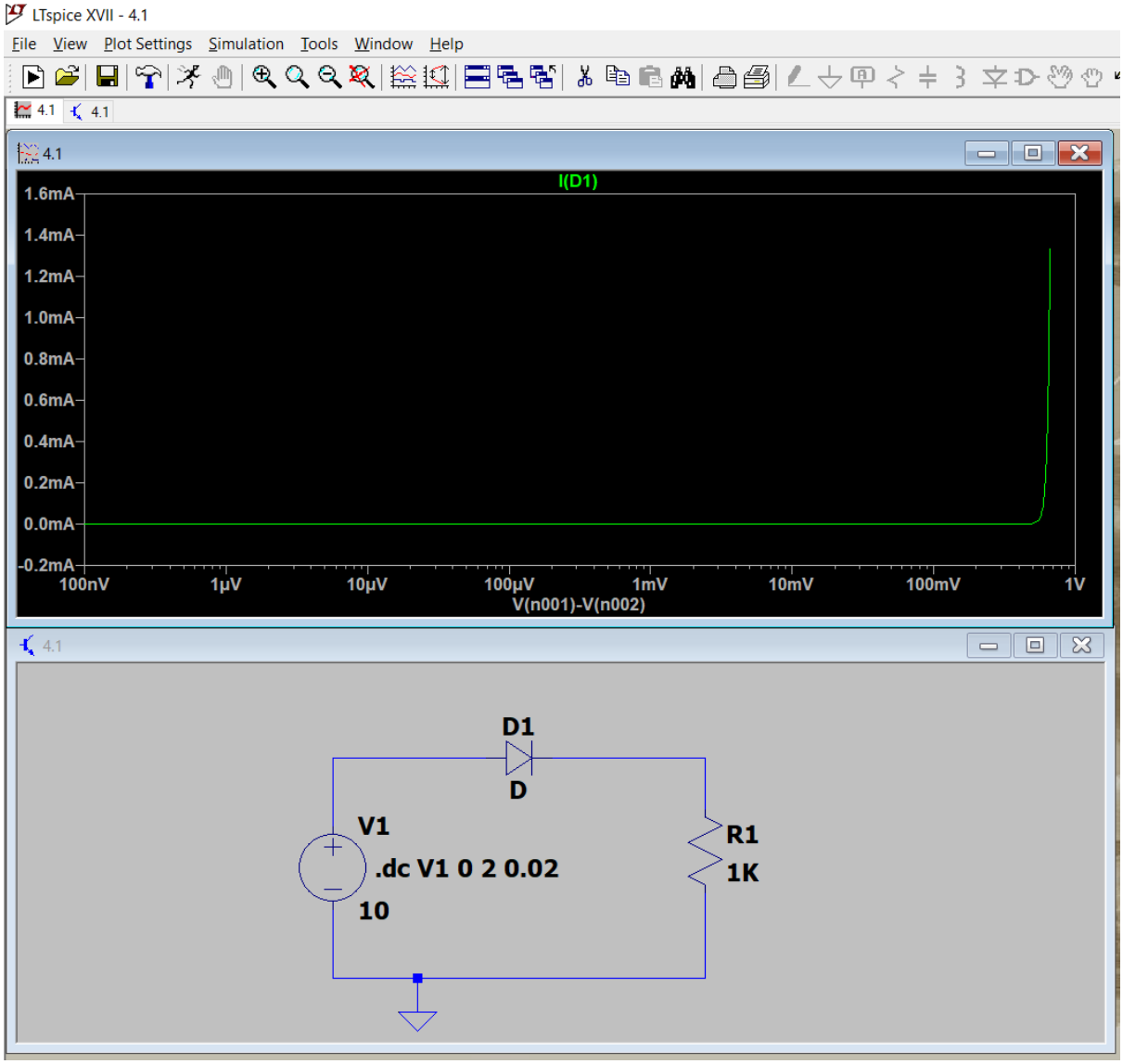
= 0.6625V

The following are the I-V characteristic curve obtained corresponding to each of the above cases

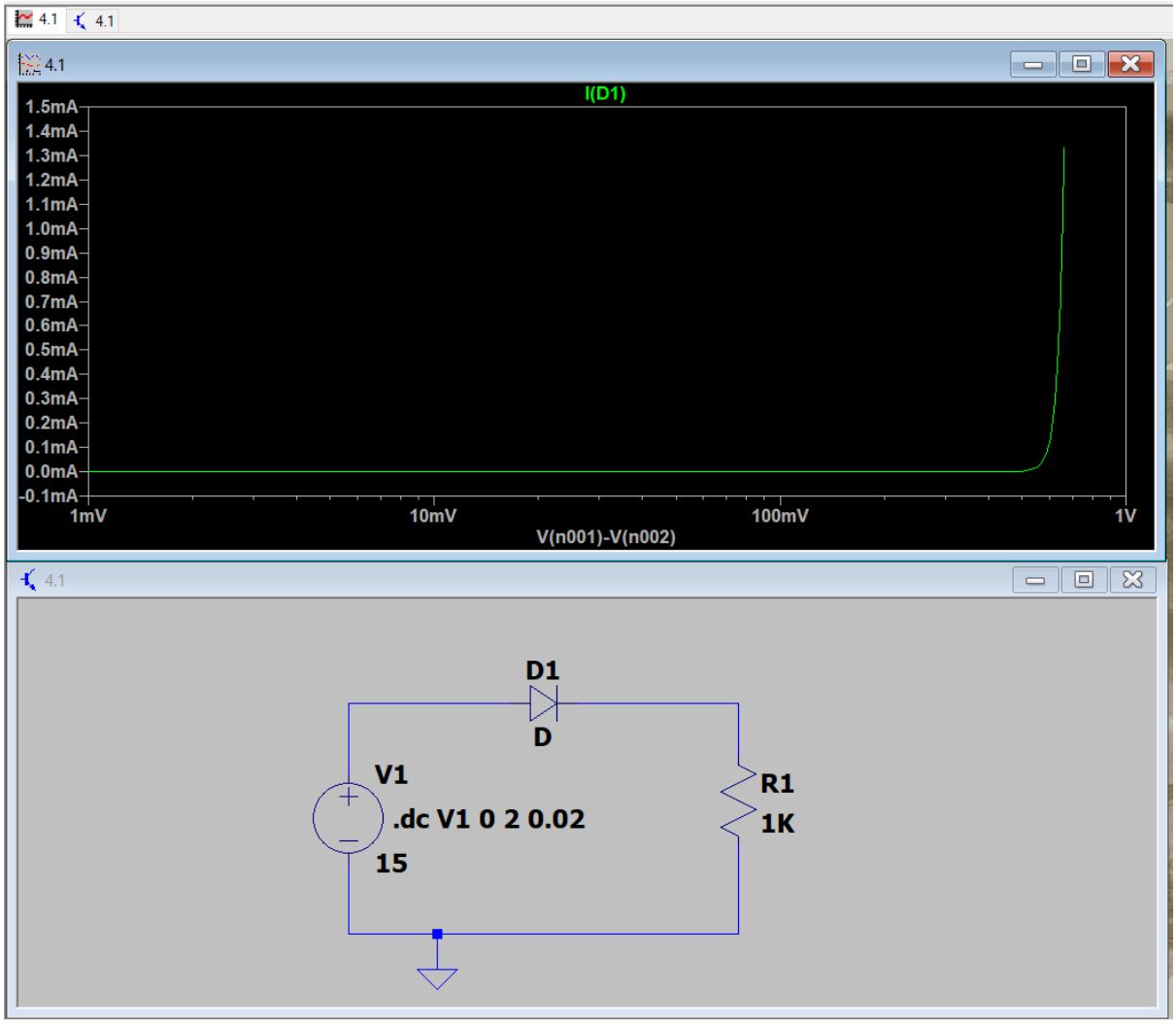
Case 1:



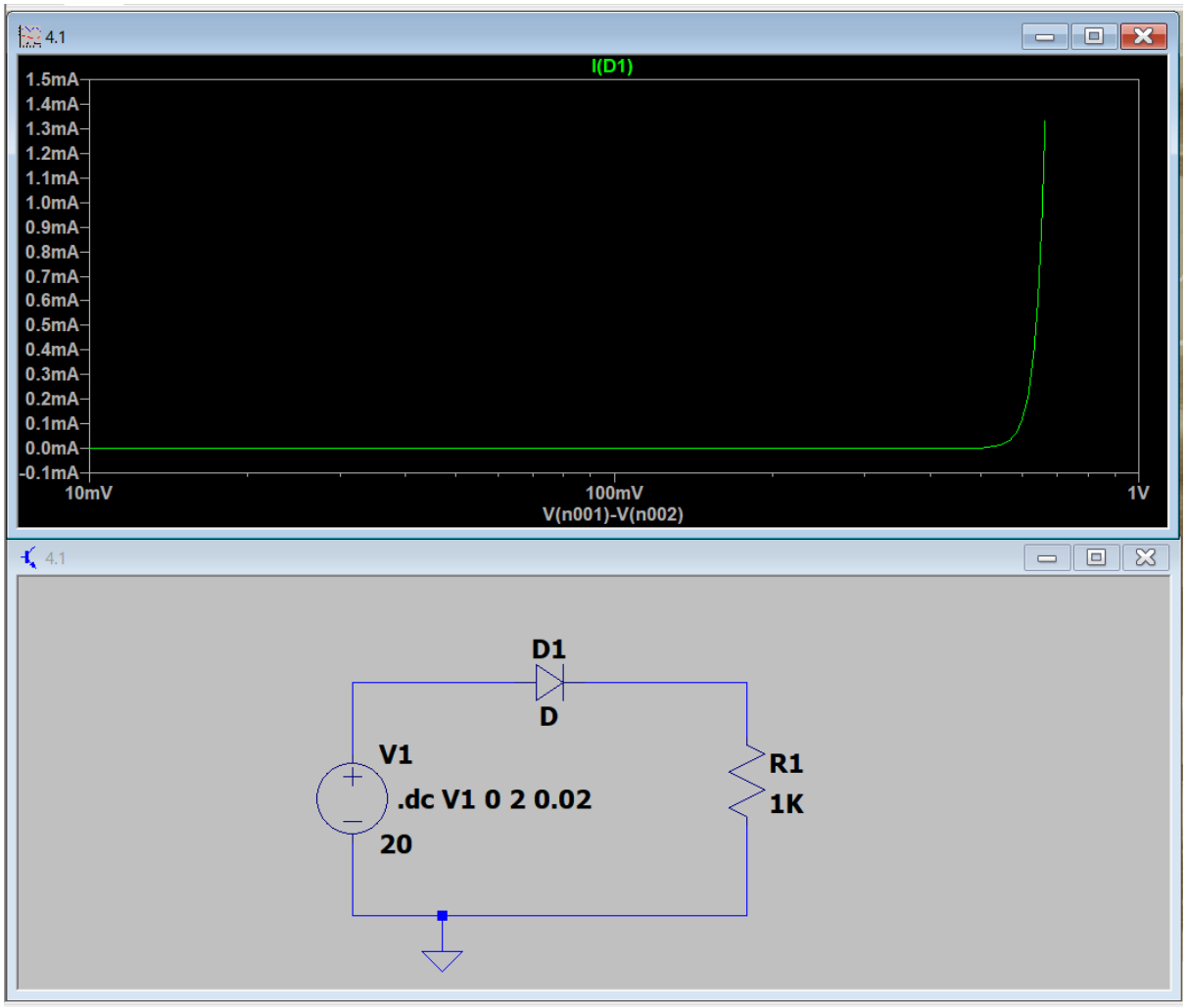
Case 2:


LTspice XVII - 4.1
File View Plot Settings Simulation Tools Window Help
4.1
I(D1)
1.6mA
1.4mA
1.2mA
1.0mA
0.8mA
0.6mA
0.4mA
0.2mA
0.0mA
-0.2mA
100nV
1µV
10µV
100µV
1mV
10mV
100mV
1V
V(n001)-V(n002)
D1
D
V1
.dc V1 0 2 0.02
10
R1
1K

Case 3:


4.1
4.1
I(D1)
1.5mA
1.4mA
1.3mA
1.2mA
1.1mA
1.0mA
0.9mA
0.8mA
0.7mA
0.6mA
0.5mA
0.4mA
0.3mA
0.2mA
0.1mA
0.0mA
-0.1mA
1mV
10mV
100mV
1V
V(n001)-V(n002)
4.1
D1
D
V1
.dc V1 0 2 0.02
15
R1
1K

Case 4:



Discussion:

If the positive (negative) terminal of a voltage source is connected to P-side (N-side) of the diode then the diode is said to be in forward bias or ON, otherwise it is reverse biased or OFF. A real semiconductor diode made of Si needs approximately 0.7 V forward bias before it starts

conducting current. In reverse bias, it conducts a negligible current which ideally should be zero. The forward current flows from p to n region.

An ideal diode is a perfect conductor for one direction of current whereas a perfect insulator for the opposite direction. However, in practice the diode does not behave as ideal conductor or insulator in any case. A junction diode is basically a semiconductor PN junction made of p-type and n-type semiconducting regions.
We can express the current using the following formula: I_0

$$\mathbf{I = I_0(e^{qV/KT} -1)}$$

Where:
I = the net current flowing through the diode;
I_0 = the diode leakage current density in the absence of light;
V = applied voltage across the terminals of the diode;
q = absolute value of electron charge
k = Boltzmann Constant and
T = absolute temperature (K).