education

Department of Education
FREE STATE PROVINCE

TECHNICAL SCIENCES

SUPPORT MATERIAL

TOPIC 7: ELECTRONIC PROPERTIES OF MATTER

GRADE 12

MARCH 2018

This document consists of seven pages.

TOPIC 7: ELECTRONIC PROPERTIES OF MATTER

Prescribed content

Semiconductor

- A semiconductor is a material which has electrical conductivity between that of a conductor and an insulator such as glass.
- Explain semiconductor with an example. (No energy band theory).

Intrinsic semiconductor

- An intrinsic semiconductor is a pure semiconductor.

Doping

- Doping is the process of adding impurities to intrinsic semiconductors.

Types of semiconductors

- Discuss n-type semiconductor.
- Discuss p-type semiconductor.
- Discuss the construction and working of a p-n junction diode.
- Study the characteristics of p-n junction diode.

Experiment 6: Study the characteristics of a p-n junction diode

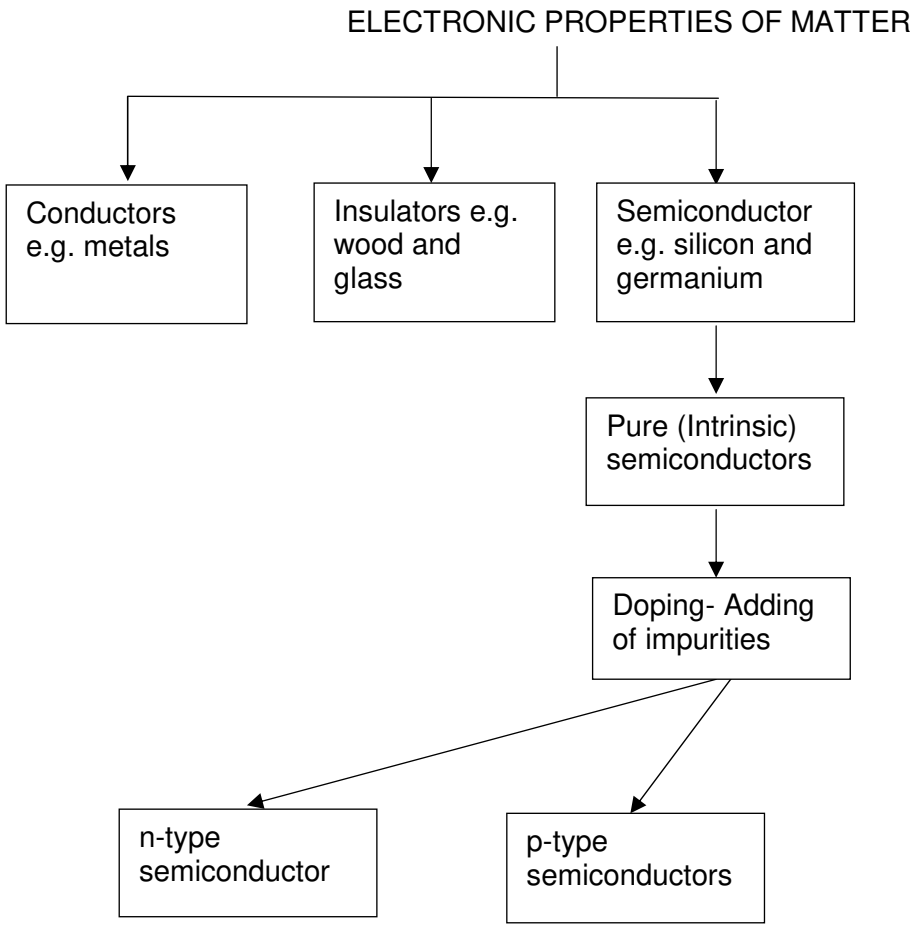
YouTube Videos

Number	Duration	Topic
1	7:53	https://www.youtube.com/watch?v=Coy-WRCfems
2	6:36	https://www.youtube.com/watch?v=OyC02DWq3ml
3	10.36	https://www.youtube.com/watch?v=TFgWDcBp-uY

Websites (internet connection needed)

Website	Topic
https://www.electronics-tutorials.ws/diode/diode_3.html	PN Junction Diode

Mind map



Important terms/definitions

Semiconductor	A semiconductor is a material which has electrical conductivity between that of a conductor and an insulator such as glass.
Intrinsic semiconductor	An intrinsic semiconductor is a pure semiconductor e.g. silicon.
Doping	Doping is the process of adding impurities to intrinsic semiconductors.
p-type semiconductor	A semiconductor material with an excess of positive charge carriers. (holes)
n-type semiconductor	A semiconductor material with an excess of negative charge carriers. (electrons)
p-n junction diode	Formed when a p-type material is combined with the n-type material by means of a special manufacturing process.

Activity 7.1

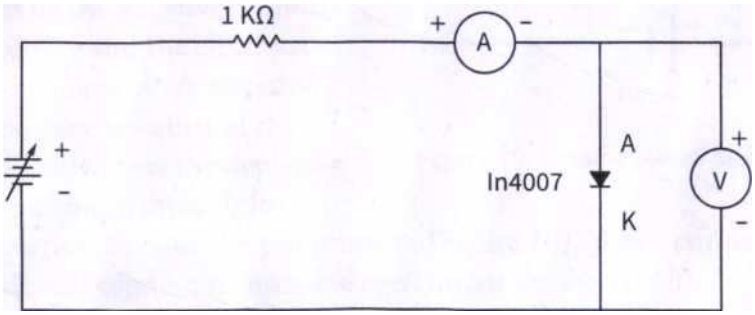
Exercise 1.1 Page 175 in textbook
Chapter revision Page 179

Experiment 6: Characteristics of p-n junction diode

Method 1

Aim: To study the characteristics of a p-n junction diode

Theory/background
The diode is a device formed from a junction of n-type and p-type semiconductor material. In this experiment, you will connect a p-n junction diode (1N4007) in series to a variable power source and a 1 kΩ resistor. You will build this circuit to determine the voltage across the diode, as well as the current through the circuit, when we change the supply voltage to the circuit.



Apparatus/materials
- Variable voltage power supply (0-20 volt DC)
- Milliammeter (0-25 mA DC)
- 1N4007 p-n junction diode
- 1 000Ω resistor
- Voltmeter (0-20 volt DC)
- Connecting wires
- Graph paper

Method/procedure

1. Connect the apparatus as shown in the Figure.
2. Switch the supply on and adjust the variable power supply to zero volts.
3. Adjust the power supply to the different voltages as indicated in the table below. Measure and record the voltage and current readings (forward biased).
4. Reverse the p-n junction diode around in the circuit and repeat steps 2 and 3 (reverse biased).
5. Record the results in the following table.

Results

Forward Bias			Reverse Bias	
V(Diode)	I(Diode)	V(supply)	V(Diode)	V(Diode)
		0		
		0.5		
		1.0		
		1.5		
		2.0		
		2.5		
		3.0		
		6.0		
		8.0		
		10		

Method 2

INVESTIGATING THE FORWARD BIAS CHARACTERISTICS OF A DIODE

Aim: To study the characteristics of a p-n junction diode

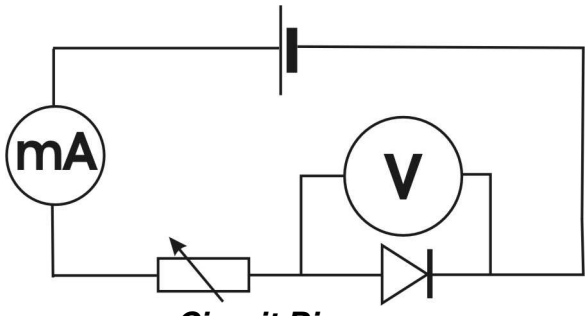
YOU WILL NEED: Circuit Board
Cell holder and pin
1.5 V D cell
Connecting leads
Mounted diode
Mounted 20 kΩ variable resistor
2 Multimeters
Small screwdriver to adjust variable resistor

YOU NEED TO KNOW:

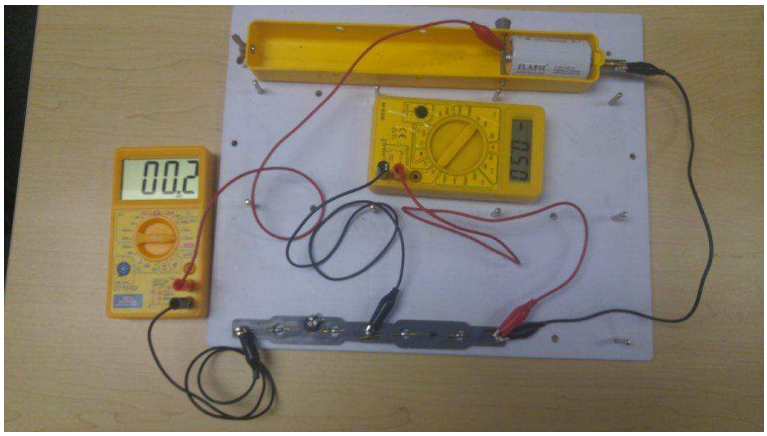
- The light grey ring end of the diode is the negative end of the diode.

WHAT TO DO:

1. Set up the circuit as shown below.



Circuit Diagram



Picture of Circuit setup

2. Set one of the multimeters on the 200 mA setting and connect this in series with the circuit as shown.
3. Set the other multimeter on the 20 V setting and connect it across the diode as shown.
4. Set the variable resistor on maximum resistance.
5. Draw up a two column table with Voltage (V) and Current (I) columns.
6. Use the screwdriver to slowly reduce the resistance on the variable resister. Note that the voltage across the diode start and the current in the circuit start to increase.
7. Increase the voltage by 0,01 V at a time ***and record the V and I readings at each stage.***
8. Continue to do this until the current reading reaches 200 mA.
9. Plot a graph of V vs. I from the readings taken.

Analysis of results

1. The p-n junction diode started to conduct from about .....V.
2. When the input voltage reaches .... V, there will be a sharp increase in the current flowing through the diode.

Conclusions

1. During the forward bias condition, with the supply voltage between 0 V and... V, no current flows through the diode. It is only when the supply voltage is increased to above .... V that the current starts to flow through the diode.
2. During the reverse bias condition, no current flows through the diode, irrespective of the value of the supply voltage.
3. Ohm's Law does not apply to p-n junction diodes