Experimental Physics I
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Lecture - 52
Expt. On RC Circuit

This is the purpose of this Experiment. Let us now show you the our setup for measuring the experiment by the way.

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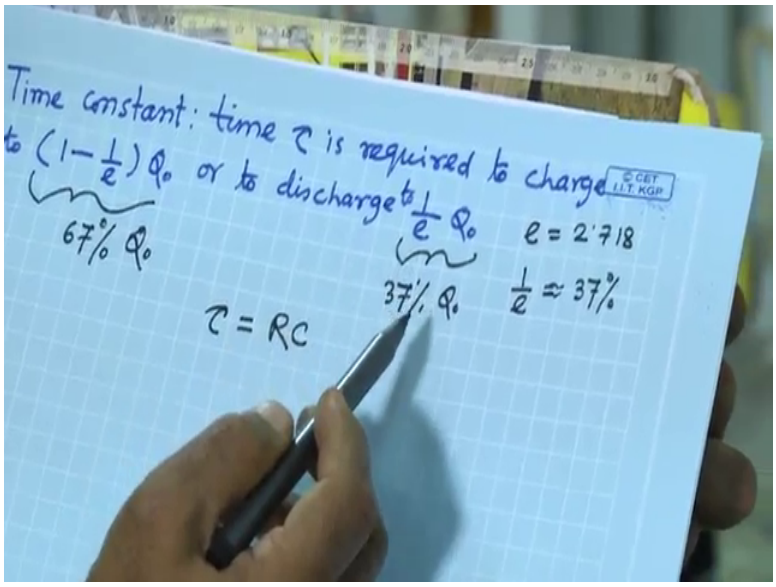

So, 1 by e basically e is 2.7 1 8. So, 1 by e is basically 0.37. So, it is a 37 percent. So, 37 percent to of Q 0 or V 0 ok, when in case of discharge when, it will discharge to it will discharge to the 37 percent of the Q 0 or V 0. So, for that whatever the time it will take so, that is the time constant RC. And, other way for in case of charging we have to tell that this is a to charge it to 67 percent 1 minus 1 by e basically 60.67 67 percent.

So, to charge it to the 67 percent of the full charge so, then so, that time it will take the circuit will take to do this. So, that will be basically time constant tau and that is equal to RC ok. So, let us show you the experiment setup experimental setup for this experiment.

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So, this is the our power supply. Basically here we will apply from here we will take the voltage for the circuit. So, here is a variable power supply we can vary the voltage. So, generally around 10 volt we will use for this experiment.

So, I will apply voltage from this power supply.

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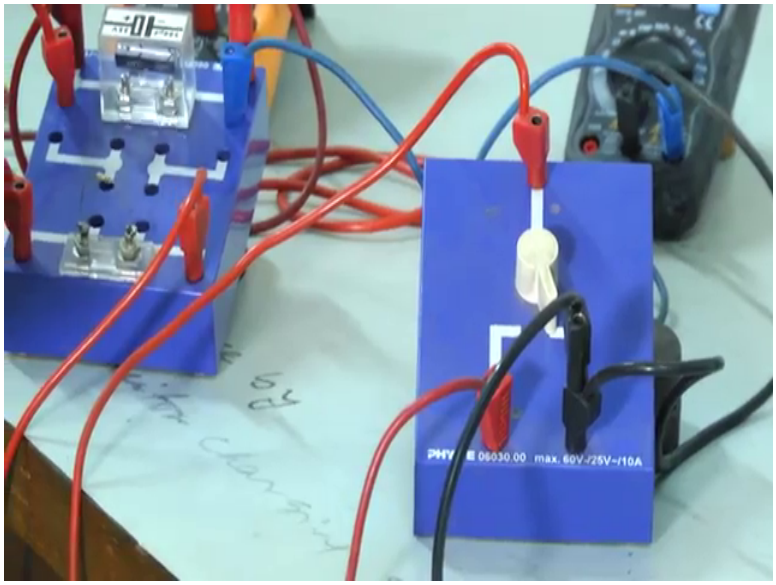

Now, this one is basically the switch s in the circuit I showed you a switch. And, so, this switch this is the switch it is a this wire is connected with the switch right and now here you can see this 1 and 2 ok.

So, now, it is connected with 2 when I will take it this way now it is disconnected and now it is connected with 1. So, as I showed you in the circuit 1 and 2 ok. So, here this arrangement so, I have switch and now I have option to connect with 1 and 2. And, 1 I showed you this it is a.

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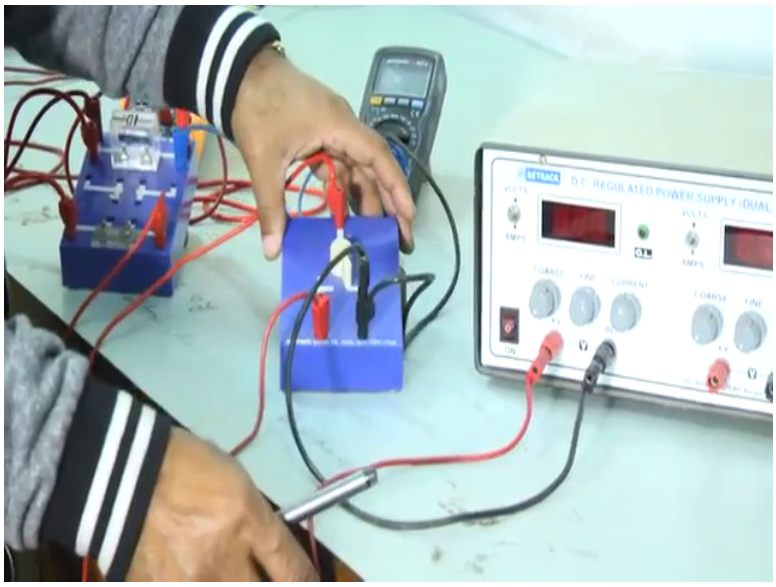

So, here connection you can see connection you can see this ok. So, let me complete it.

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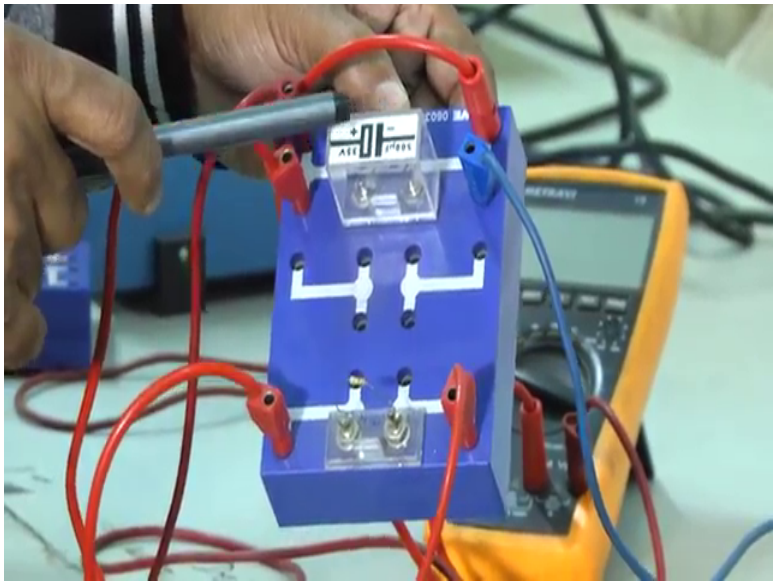

So, now this one is this one not L this R and this one is C ok. So, this one is r and this one is C. So, now, the circuit if I start from here, so as I showed you so, here switch.

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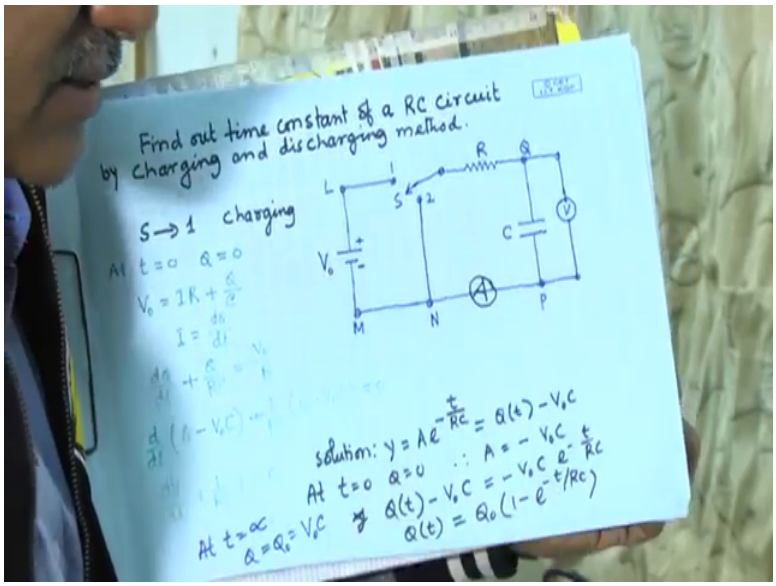

So, this is the switch this is the switch right. Now, this S I have option to connect with 1 or connect with 2 so, this I have this 2 option. Now, if you just consider that 1.1. So, 0.1 is this one ok. So, this is going this is connected this one is connected with the with the power supply. So, this is connected with the power supply ok.

This is connected with the power supply ok. One is connected with the power supply, 1 end of the power supply, 1 electrode of the power supply ok. Now, others electro negative electrode of the power supply is going, other electrode of the power supply is going to connect with is going to connect with 2 is going to connect with 2 here this is the connection is connected with 2 right, it is connected with 2, as well as it is connected with 2. As well as it is going to the ammeter it is going to the ammeter. So, that is what it is going to the ammeter.

So, from this is the common 0.1 is going to 2, 1 is going to 2 and another is going to the ammeter. So, this is the connection it is a this is the ammeter. So, this is the ammeter this is the ammeter. So, 1 is going to the ammeter. So, other end of the ammeter is going other end of the ammeter is going to the capacitor, other end of the other end is going to the capacitor other end is this one. So, other end is this one it is going to the this one end of the capacitor. And, other end of the capacitor other end of the capacitor is going to connect to the resister right going to the correct to the resister. So, that is why other end is correct to the resister.

So, now through the resister is the through the resistor. So, it is a connected here through the resister it is going to the switch, through the resister it is going to the switch ok, through the resister it is going to the switch. So, your circuit whatever I have drawn. So, I showed you the circuit here ok. So, 1 part is left this voltmeter is connected across the capacitor.

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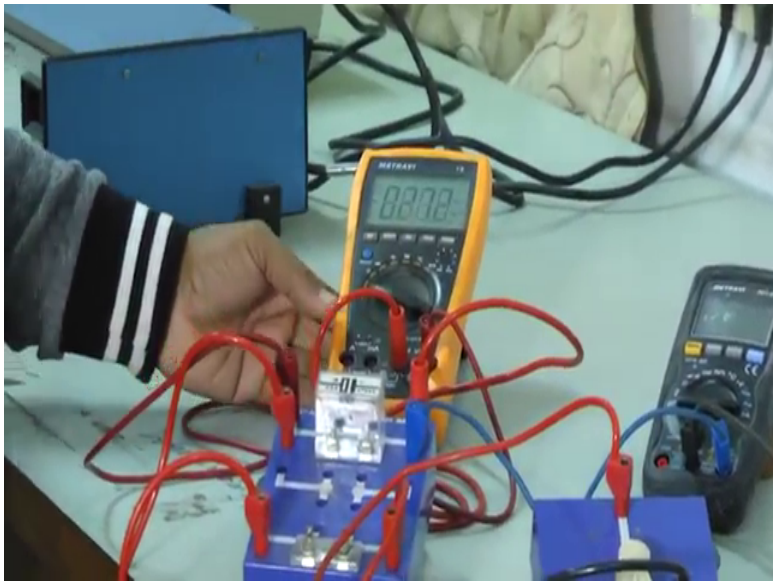

So, across the capacitor this voltmeter, so this voltmeter is connected across the capacitor right. So, here you can see this is the one end of this capacitor here ok. So, in this board basically it is internally connected. So, it is the across the capacitor this voltmeter is connected right.

So, whatever I have drawn the circuit. So, that in our experimental setup first we should check the circuit we should make the circuit. So, I have made and showed you right. Next what are the, what is the experiment we will do. So, first charging of the circuit right so, I will just switch on this power supply. And, I think I will as I told I will select around 10 volt, around 10 volt I have to I think I have to switch on this multi meter.

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It is a these are basically multi meter it has option for measurement of voltage current. So, this we are using as a in voltage mode to measure the voltage and this we are using to measure the current mode.

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You see just it is now in the position of discharging it is the position of discharging ok. So, here initially some charge was there in capacitor. So, I will make it short to discharge it is, but it is in milli volt order. So, very small it is the milli volt order very small so, but I can make it almost 0, I can make it almost 0s are just across the capacitor I will just

make it shorten. So, I see it is the all it is 0 and current also in the circuit is 0 current also in this circuit is 0 right.

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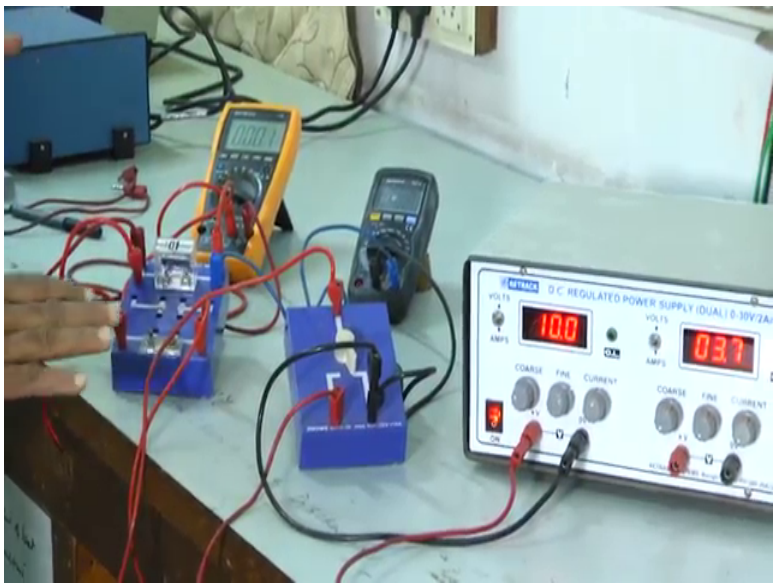

So, now, so, what we will do I will just so, it is in discharge mode ok. Now, there is no charge in the capacitor. So, that is why it is the reading is you see almost 0 right, it is a 0.3 milli volt it is current is 0 in the circuit. Now, we have to note down at t equal to 0, what is the voltage, what is the current?

Now, I need stopwatch I need stop watch. So, so, so what I have to do I will just start charging and then in every 5 second what is the reading of voltage, or what is the reading of current that we have to note down ok. This actually we need 2 people to do this experiment. So, one will see the time and another will write the reading of this voltmeter or connector. So, at a time both we cannot take. So, twice we have to do the experiment. First for charging you just measure the just take reading of voltage and then discharge it; during discharge again you measure the take the reading of voltage ok.

So, then I will I will repeat the experiment same experiment I will repeat, but that time again I will make it shortened and make it 0 and then I will start for charging and that time I will take the reading of the ammeter current reading. So, during charging I will take current reading during discharging again I will take the current reading. So, you will have 4 sets of data; one is during charging voltage versus time that data you have to

collect. So, this table is very simple time in table this time I think I can show you just I have here. So, table is very simple.

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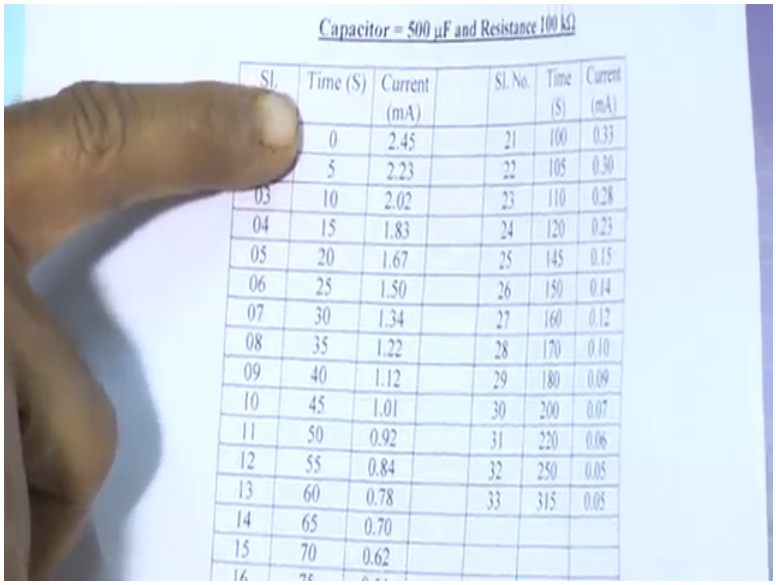

So, time and this current or voltage this current time versus this ok, serial number and then this time right in second current in milli ampere ok, so, again same way this for voltage and this for charging as well as discharging. So, you will have this core table ok.

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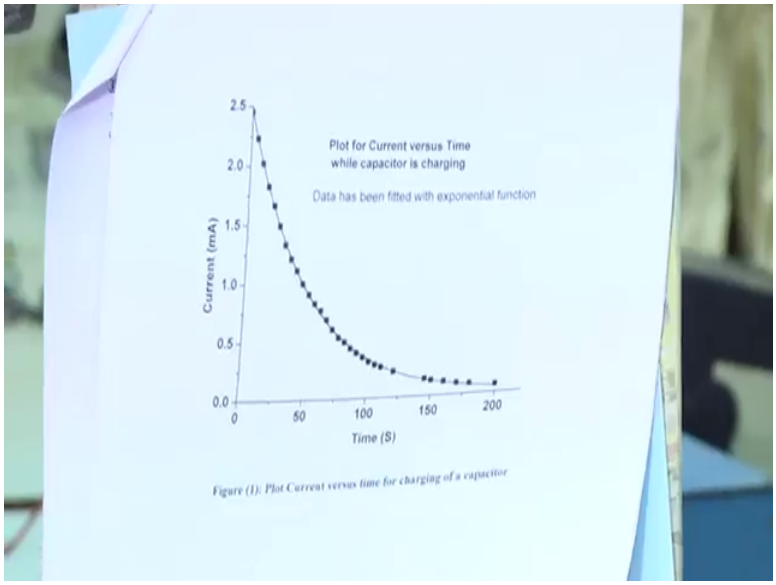

And, then you have to plot you have to plot reading if you just plot then exponentially it is decaying or it is increasing that you can show as I discussed. So, this is the experiment

simple experiment, but you have to take data very carefully, because we have to we have to take data of time as well as we have to take data of the voltage or current. So, you need help of other people, another your friend or 2 people need for doing this experiment.

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So, now, just anyway so, I will use this stopwatch, I will use this stopwatch, I will start ok, when just I will start charging I will start timing.

So, as I told 1 has to note down this every 5 second. So, someone will tell 5 10 15 20 and other one just immediately should note down this reading ok. So, I will just not use this stopwatch now, but here just I want to show you the variation of current or voltage with time during charging. So, and you know this in every 5 second we have to note down this data ok. So, just here let me show you first this voltage variation ok, when I will start the charging and you have to take data as long as it is going towards the maximum value of the voltage.

So, maximum what will be the maximum value of the voltage it should be the value of this one, but it will take long time, but when we will get approximately 10. So, we will stop the experiment. So, let us show you the charging, yes the charging is started see every 5 second you have to now it has gone to volt you know from milli volt to it has gone to volt. So, 1.5 1.6 1.9 2.2 2.4 volt is volt initially it was milli volt.

So, now, 3.2 3.4 3.6 3.8 so, in every 5 second we are taking the reading we are noting down. So, you see it is taking time to it is a middle way it is the middle way, but initially it is very fast ok, it is going to a full charge from 0 to it is full charge. And so, this way it will go towards the 10 ok.

Let me show you this what that fellow is doing, you see it is a this current is decreasing, it is a milli and micro ampere this current is in microampere you see with time current is decreasing. As, I told during charging voltage will increase charge will increase, but current will decrease exponentially it will decrease. So, that is what here you are seeing current is decreasing.

So, this also we have to note down this how what is the current value in every 5 second. So, that you have to note down ok. So, as I told twice you have to do this experiment 1 once you will you will take reading for volt and this next time you should take this for current. Similarly so, when it will be full charge it is not yet it is not charge is not full yet it is the 8 volt now it is the 8 volt. So, now, it will be slow you know, this curve is as I showed you as I showed you, it is a this variation will be now little slow it is very slow ok.

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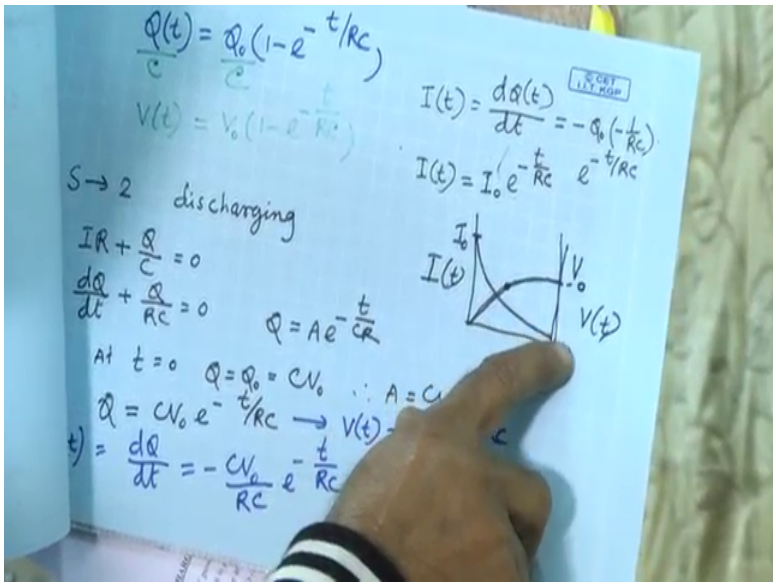

So, now we are in this region you know in this region. So, variation here it is a is very slow, but current will be faster also current here also it will be it will be slow now going towards the almost 0.

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So, that is what is happening that is what is happening here, you see current is almost 5.2 5.1 current also variation will be slow, but it is going towards 0, it is going towards 0. So, yes 4.5 micro ampere 4.4. So, this way it is going towards 0 and it is going towards 10 ok, it is going towards 10. So, we have to note down this both reading for current and voltage ok. And, then actually we will plot that data and we will plot the data, we will plot the data and you will get the curve.

And, then we will use lock plot to find out the slope of the lock plot and that inverse of slope will be the your RC. Now R value and C value is if it is known to you ok. So, in our case we have used this we have used this capacitor this 500 microfarad and resister we have used this is 100 100 kilo Ohm ok. So, if you multiply this 2, then it will be it will be 50 second ok. So, theoretically so, RC will be time constant will be 50 second and from your plot experimental data when we will plot from there.

What is the RC, what is the time constant you are getting. So, that you have to note down. So, and then for 4 curves you can find out this 4 value of time constant and you take the average of them then it will so ok. So, it is going towards of this is 8.9 and this also it is a 1.7 it is the 1.7. So, it takes time ok. So, this so, I think I will not wait I will not wait it is. So, I think it will take some more time to charge fully.

But, you have to do this you have to wait for full charge, but I think I will start the discharging from here. So, then you see. So, it is the how this it discharged. So, for

voltage what we have seen, it will discharge exponentially current also discharge exponentially, but current will be negative. So, look at this look at this it is a positive value. And, this is the also is a positive value and now let me just go to the connect this switch to the 2 then is the discharging. So, I have done.

Now, you see it is discharging it is the decreasing and you see you see current is you see current is decreasing, but it is exponentially decreasing so, but it is a negative value it is the negative value ok.

So, in that case you can tell that is increasing since it is negative value and this value is decreasing. So, that way is the increasing ok. So, but if you ignore this negative value negative sign, then is basically this also is the exponentially decaying this is also exponentially decaying value ok. So, that you have to note down. So, this is the experiment this is the simple experiment and but, you get very important information about the variation of current voltage in the circuit as well as charge in the circuit and from there time constant we can find out.

So, what is the time constant what is the time constant and what is the significance of the time constant? So, for a particular for a particular circuit how long it will take time to full to get full charge or to get fully discharge so that you can estimate from time constant ok. So, I think I was able to tell you properly of this experiment and other things after that you have to calculate RC, as I told from graph you have to use graph as well as we have to do error calculation we have to do discussion and precautions.

So, I think this I will this take it as a homework, I think you should be able to do it, because I have discussed this other parameters like discussion like error calculation how to write the result; so, in other experiment. So, I will not repeat that same thing in all experiment. So, I will stop it.

Thank you for your attention.