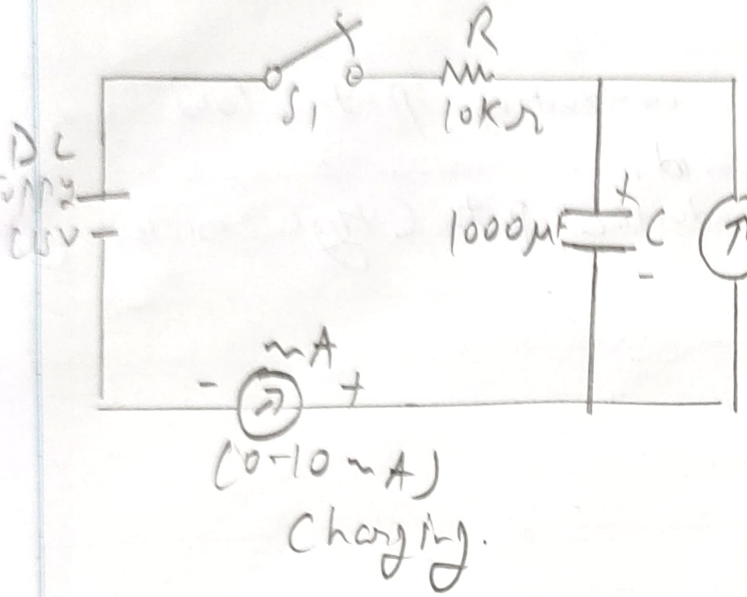
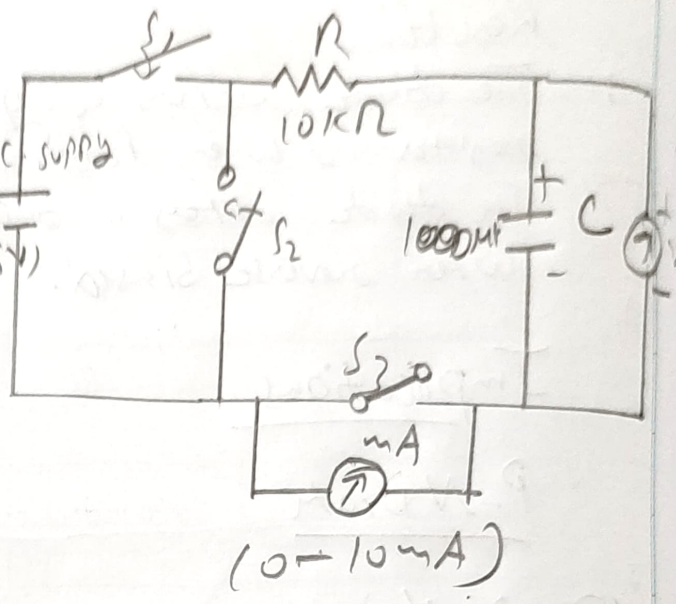
Circuit Diagram





Observation

Least count of milliAmmeter = 0.05 mA

Least count of Voltmeter = 0.2 V

For charging.

S.No	Time (Seconds)	current (I) division x L.C: (mA)	Voltage div x L.C.) (V)
1.	5	12 X 0.05 = 0.6	2.6 = 0.2 = 0.52
2.	10	8 X 0.05 = 0.4	4.7 x 0.2 = 0.9
3.	15	5X 0.05 = 0.25	6.3 X 0.2 = 1.26
4.	20	4 X 0.05 = 0.2	6.7 X 0.2 = 1.34
5.	25	3 X 0.05 = 0.15	6.9 X 0.2 = 1.37
6.	30	2.5 X 0.05 = 0.125	8.1 X 0.2 = 1.62

Date 26/4/23

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Experiment No. -3

Object: To study charge and discharge of a condenser through a resistor.

Apparatus required: D.C. supply (15 volt, 25 mA), Resistance (10kΩ, 50kΩ), Capacitor (500μF & 1000μF). D.C. voltmeter (0-25 V), D.C. Milliammeter (0-10 mA) - Toggle Switches. Stop clock

Formula used:

(1) Charging equation for the capacitor, C through a resistor R is given by

$$q = q_0(1 - e^{-t/RC})$$

where RC is time constant and q_0 is maximum charge required by the capacitor. The corresponding current equation is

$$i = \frac{dq}{dt} = \frac{q_0}{RC} e^{-t/RC} = \frac{CE}{RC} e^{-t/RC} = i_0 e^{-t/RC}$$

(2) The discharge equation are

$$q = q_0 e^{-t/RC}$$
$$i = -i_0 e^{-t/RC}$$

where $i_0 = E/R$ and time constant is RC.

Procedure:

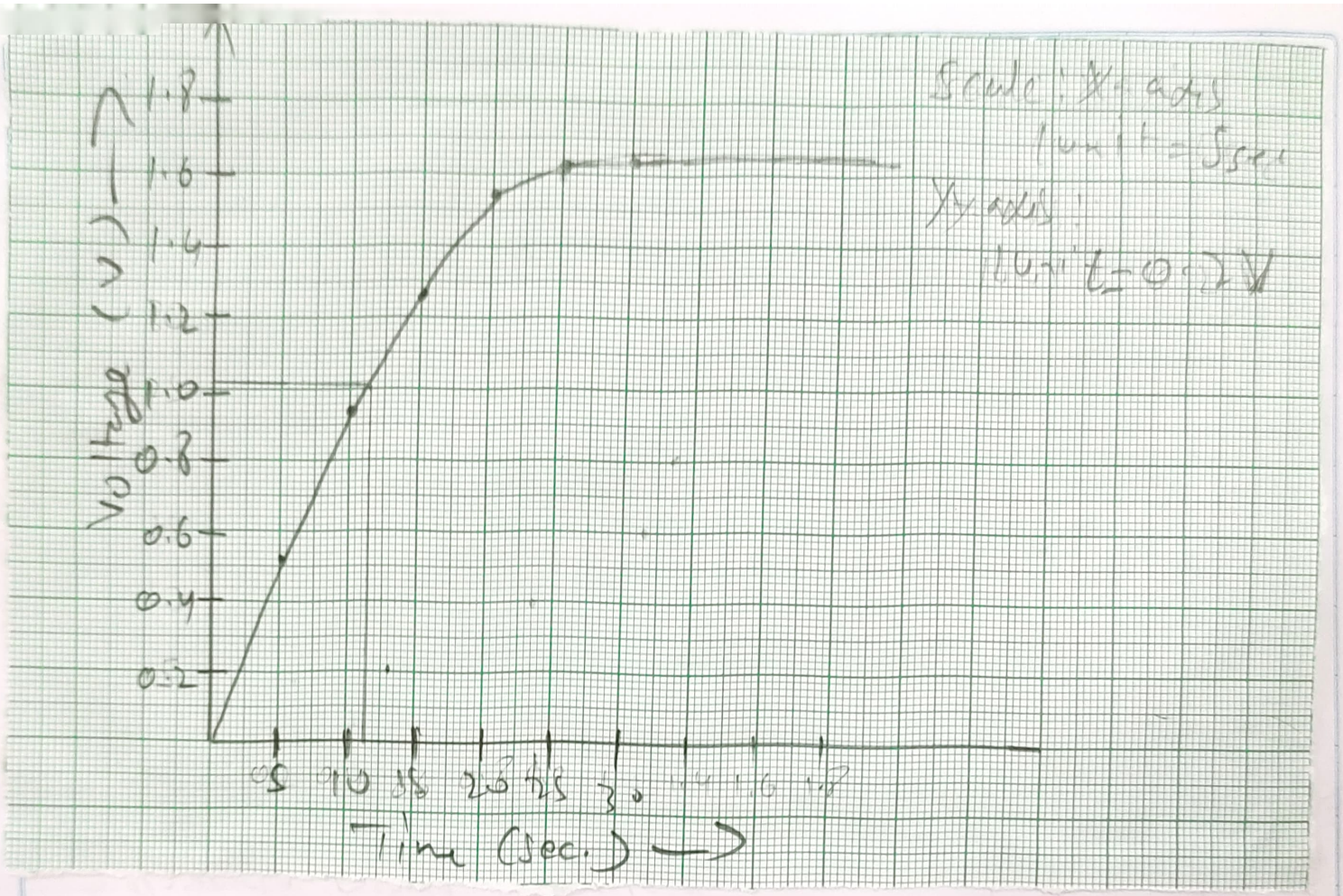
(A) For charging of condenser:

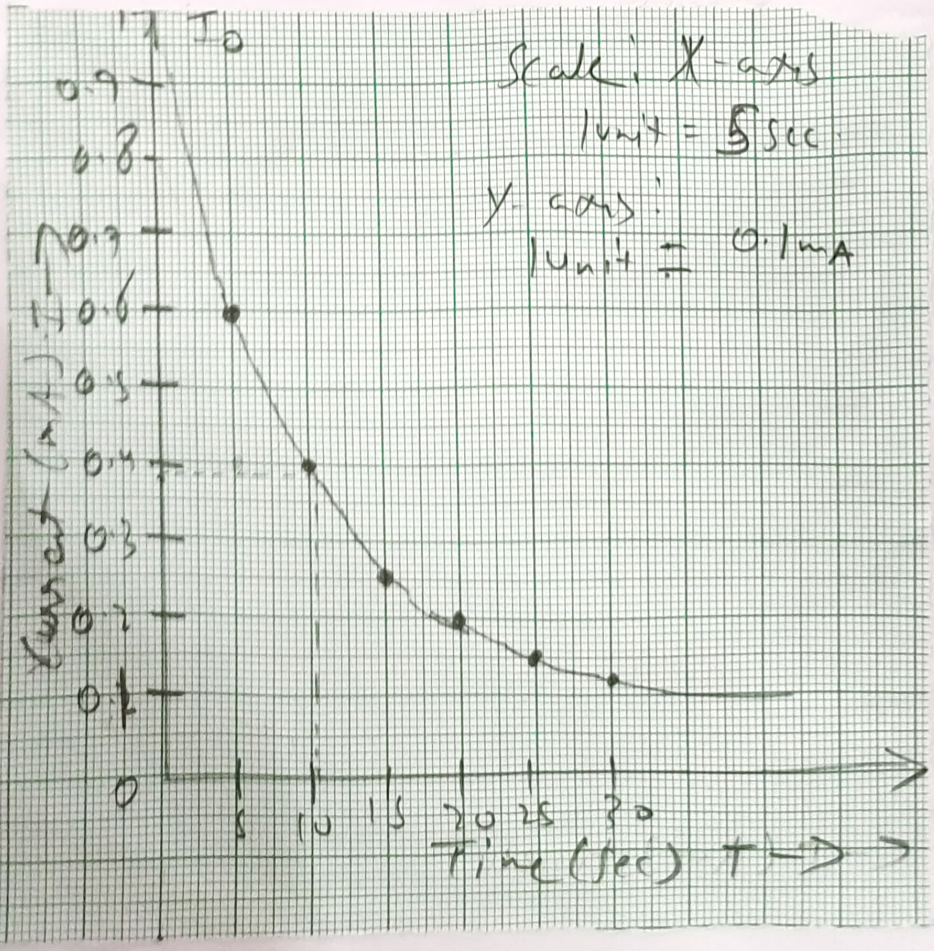
i) Link the circuit as show in fig. switch S_1 is open

ii) Close switch S_1 and simultaneously start a stop clock.

iii) Reading in voltmeter will increase while current in milliammeter will decrease. Record readings of voltmeter and milliammeter after every 5 sec. till voltage reaches a maximum

Teacher's Signature


Scale: X-axis
1 unit = 5 sec
Y-axis:
1 unit = 0.2 V
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
5
10
15
20
25
30
Time (Sec.) →


I_0
Scale: X-axis
1 unit = 5 sec
Y-axis:
1 unit = 0.1 mA
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5
10
15
20
25
30
Time (Sec) t →

and current a minimum.

iv) Repeat the experiment by changing R and C

(B) For discharge of condenser:

i) Link the circuit as shown in figure 2 keep S_1 and S_2 switches open while S_3 closed

ii) Close S_1 till reading in voltmeter reaches maximum value

iii) Then open S_1 close close S_2, S_3 is already closed, condenser will start discharging across R, Reading in voltmeter will decrease. Take reading of voltmeter after every 5 seconds. till reading becomes minimum.

iii) For discharge current, open S_2 again close S_1 so that reading in voltmeter reaches a maximum. Then open S_1, open S_3 and close S_2, Reading in milliammeter will start increasing. Take its reading after every 5 seconds

Calculations:

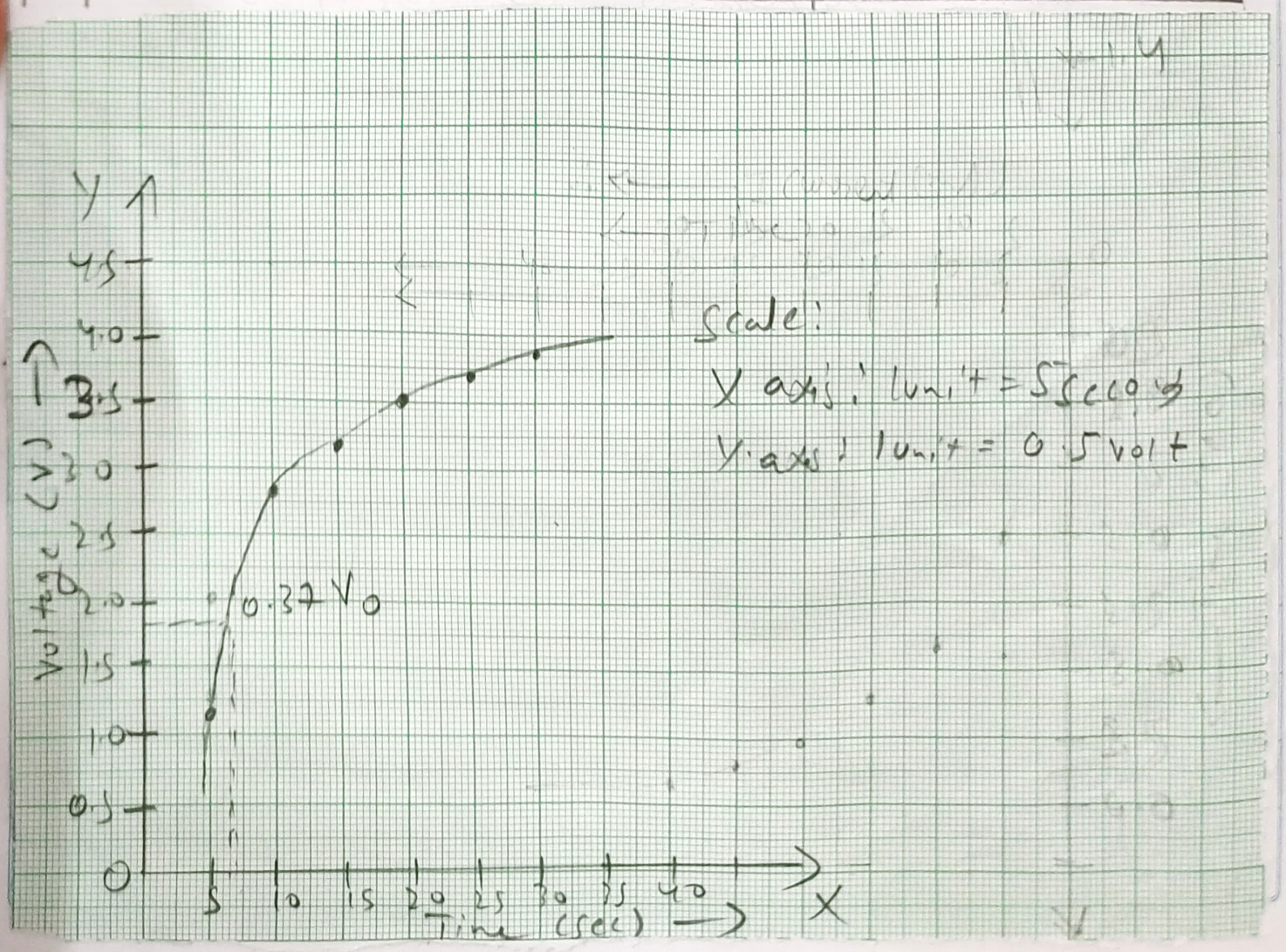
(A) for charging of condenser: Plot a graph in voltage and time and other in current and time.
If maximum voltage reached is V_0 then time constant is the time corresponding to the point where voltage $0.63V_0$ compare it with theoretical value of RC.

(B) For discharge curves: Plot one graph in voltage and time. and other in current and time. Find time constant which is the time corresponding to the point where voltage is $0.37V_0$. Compare it with theoretical value.

Teacher's Signature

For discharging

S.No.	Time (Sec)	Current Div × L.C. (mA)	Voltage Div × L.C. (V)
1.	5	25 × 0.05 = 1.2	6 × 0.2 = 1.2
2.	10	16 × 0.05 = 0.8	14 × 0.2 = 2.8
3.	15	10 × 0.05 = 0.5	16 × 0.2 = 3.2
4.	20	6 × 0.05 = 0.3	17.5 × 0.2 = 3.5
5.	25	4 × 0.05 = 0.2	18.5 × 0.2 = 3.7
6.	30	2.5 × 0.05 = 0.125	19 × 0.2 = 3.8



Date

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Result:

1. Time constant of circuit from the graph 10 sec.
2. Theoretical value of time constant = 10 sec.

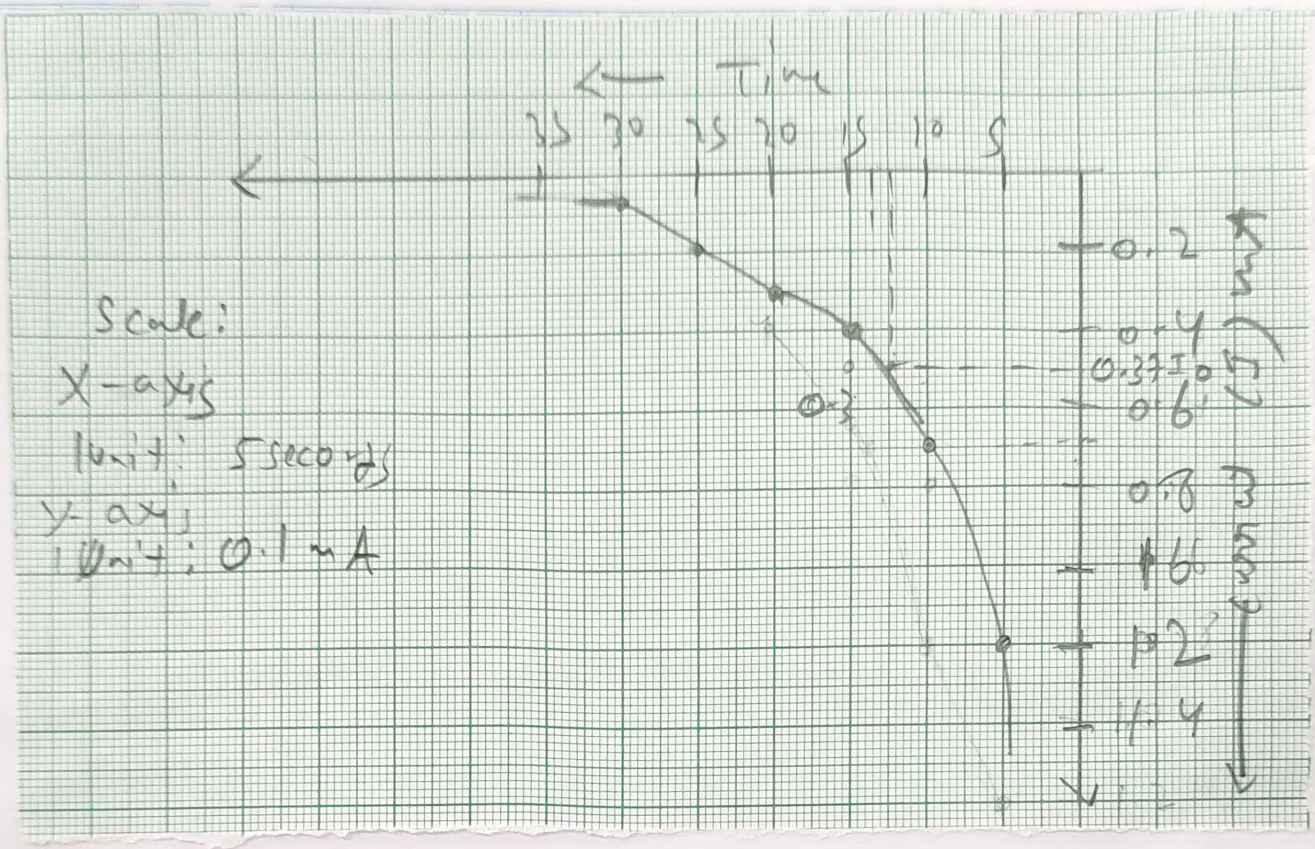
Sources of errors and Precautions:

i) It is better to use voltmeter and milliammeter having small least counts
ii) Condensor should not be leaky.
iii) Appropriate values of R and C given quite a good number of observations should be used.

Implications

1. Capacitors can store electric energy during charging it can dissipate store energy and can be used like temporary battery.
2. Capacitors can provide upto 360 J/kg of energy density. Can be used in car audio system for amplifier to use as demand.
3. Basically constructed low inductance high voltage capacitors can be used in supplying huge pulse of current for many pulsed applications, pulsed supply can be used in electromagnetic forming, generators, pulsed lasers, research particle accelerator.

Teacher's Signature



Calculations

Time constant (T.C.) = RC
= 10KΩ × 1000μF
= 10 seconds

Maximum of current in charging = I_0 = 0.6 ⇒ 0.63 × I_0 = 0.37

Time corresponding to $0.63V_0$ = 10 seconds ✓

Maximum value of voltage in charging = V_0 = 1.62 ⇒ 0.63 V_0 = 1.02

Time corresponding to $0.63V_0$ = 11 seconds

Maximum value of current in discharging = I_0 = 1.2

$0.37 I_0 = 0.37 \times 1.2 = 0.444$ mA

Time corresponding to $0.37 I_0$ = 12.5 seconds

maximum value of voltage in discharging = V_0 = 3.8

Time corresponding to $0.37 V_0$ = 7 seconds