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Phys111 Report

Experiment #9: RC Circuit

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(1) Abstract:

- **Aim of the experiment:**

To find the value of an unknown capacitor experimentally using a resistor with known value throughout charging and discharging the capacitor.

- **The main results are:**

*τ = 42 $\pm$ 1 sec
*C = 47 $\pm$ 4 µF

(2) Data:

Charging				Discharging			
Time (sec.)	**V_c (volts)**	**Time (sec.)**	**V_c (volts)**	**Time (sec.)**	**V_c (volts)**	**Time (sec.)**	**V_c (volts)**
0	0.000	**70**	3.978	**0**	4.918	**70**	1.040
5	0.664	**80**	4.165	**5**	4.470	**80**	0.843
10	1.112	**90**	4.302	**10**	3.944	**90**	0.685
15	1.505	**100**	4.433	**15**	3.486	**100**	0.557
20	1.919	**110**	4.528	**20**	3.147	**110**	0.455
25	2.279	**120**	4.611	**25**	2.787	**120**	0.373
30	2.544	**130**	4.666	**30**	2.469	**130**	0.306
35	2.824	**140**	4.720	**35**	2.234	**140**	0.248
40	3.032	**150**	4.759	**40**	2.022	**150**	0.209
45	3.252	**160**	4.790	**45**	1.796	**160**	0.170
50	3.416	**170**	4.816	**50**	1.627	**170**	0.142
55	3.589	**180**	4.837	**55**	1.416	**180**	0.119
60	3.718	**190**	4.854	**60**	1.286	**190**	0.100
65	3.857	**200**	4.868	**65**	1.168	**200**	0.084

$R = (9.1 \pm 0.5) \times 10^5\ \Omega$	$C_{manufacture} = 47\ \mu F$

(3) Calculations:

Charging/Discharging graph

$\tau_C = 40$ sec	$\tau_D = 43$ sec

Semi-log graph

$Slope = -0.022627524\ sec^{-1}(\frac{1}{sec})$

$\tau_S = -\frac{1}{Slope} = -\frac{1}{-0.022627524} = 44.19396339$ sec

$\bar{\tau} = \frac{\tau_D+\tau_C+\tau_S}{3} = \frac{43+40+44.19396339}{3} = 42.3979878$ sec

$\Delta\bar{\tau} = \frac{\sigma_s}{\sqrt{N}} = \frac{2.160820735}{\sqrt{3}} = 1.247550433$ sec

(4) Results:

$C = \frac{\bar{\tau}}{R} = \frac{42.3979878}{9.1\ x\ 10\text{^}5} =$
➔ $4.659119538 \times 10^{-5}$ F ➔ $46.59119538 \times 10^{-6}$ ➔ **47 µF**

$\frac{\Delta C}{C} = \frac{\Delta\bar{\tau}}{\bar{\tau}} + \frac{\Delta R}{R} = C \times (\frac{\Delta\bar{\tau}}{\bar{\tau}} + \frac{\Delta R}{R}) =$
➔ $4.659119538 \times 10^{-5}$ **X (** $\frac{1}{42} + \frac{0.5\ x10\text{^}5}{9.1\ x\ 10\text{^}5}$) = $3.669269966 \times 10^{-6}$ F ➔ **4 µF**

$*\tau$ = 42 ± 1 sec
$*C$ = 47 ± 4 µF

(5) Conclusions:

C ±

After I did the readings and calculations ,I need to make the Discrepancy Test to check if the result is accepted or not :
***Discrepancy Test = |true value – exp. Value| ≤ 2 × error**
= |47µ – 47µ | ≤ 2 x 4µ ➔➔➔ 0µ ≤ 8µ ➔➔➔ 0 ≤ 8
The result is accepted. (The true value of C is 47 µF).

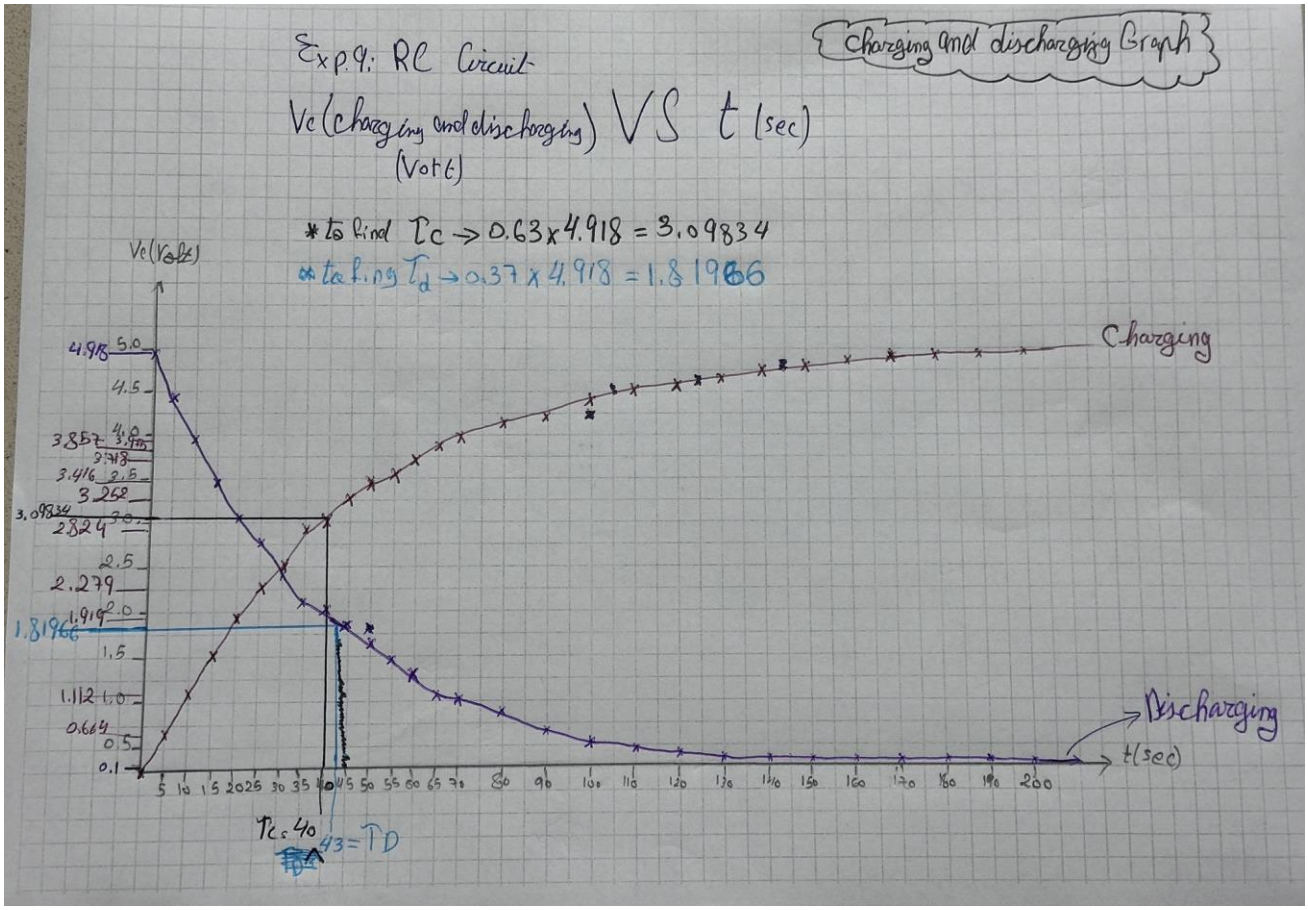
The acceptance of experimental results relies on the precision and accuracy maintained throughout the experiment.

Mistakes can lead errors, causing the results not to be accepted. Poor circuit connections and environmental effects, such as temperature changes, can introduce errors.

Increasing resistance (R) in a charging capacitor process slows down the charging rate. In the discharging process, higher resistance (R) results in a slower discharge rate.

However, increased resistance slows down both charging and discharging times in an RC circuit with reference to the equation τ **= CR.** To sum up increasing R leads to increase in the time constant causing the delay in the process of charging and discharging the capacitor.

Charging & discharging Graph



Semi Log Graph