PH101L Applied Physics Lab

Open-Ended Lab

Lab Report

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1. Introduction

The task involves analyzing and designing a circuit to meet a specific requirement for charging time;

◼ We are to verify that the capacitor charges up to 2.85 V (57% of 5 V) in 27.85 seconds.

2. Calculation

- All Calculations related to R and C by using charging/discharging equation of capacitors.

$$V(t) = Vmax\left(1 - e^{-t/RC}\right)$$

$$0.57 = 1 - e^{\frac{-t}{RC}}$$

$$0.57 + e^{\frac{-27.85}{RC}} = 1$$

$$e^{\frac{-27.85}{RC}} = 1 - 0.57 = 0.43$$

$$\ln e^{\frac{-27.85}{RC}} = \ln(0.43)$$

$$\frac{-27.85}{RC} = \ln(0.43)$$

$$RC = \frac{-27.85}{\ln(0.43)} = 33 \, seconds$$

When using the formula for the charging of an RC circuit, we take the percentage to which the circuit is to be charged, in decimal form, and the **Vmax** is to be set at **1**.
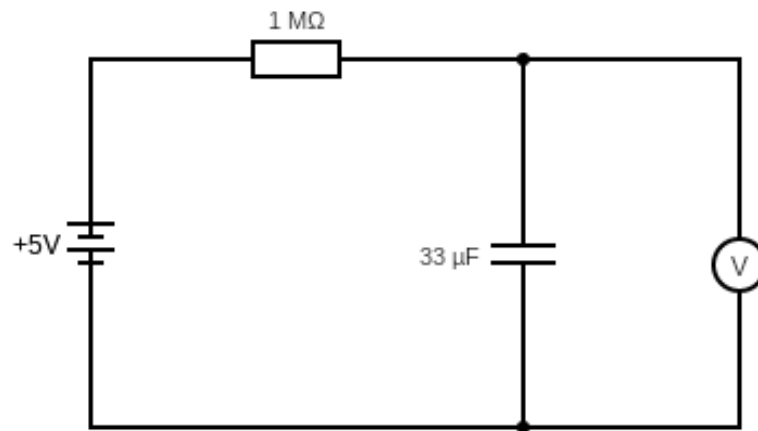
33 seconds = 33μF * 1MΩ

The **resistor** is to be taken of value **1 Mega ohm**, and the **capacitor** is to be taken of capacitance, **33 micro farads**.

[0.57 * 5 = 2.85 Volts]

3. Circuit Diagram

- Include a labeled circuit diagram showing the voltage source, capacitor, resistor.
- You can draw the circuit diagram online [https://www.circuit-diagram.org/]

4. Data

A. Charging Voltage of a Capacitor

Time (t)	Voltage $V_C(t)$
5	0.68
10	1.29
15	1.77
20	2.17
25	2.54
30	2.82
35	3.07
40	3.27
45	3.45
50	3.58
55	3.71
60	3.81
65	3.89
70	3.96
75	4.02

B. Discharging Voltage of a Capacitor

Time (t)	Voltage $V_C(t)$

C. Charging Current of a Capacitor

Time (t)	Current $I_C(t) = C\dfrac{dv}{dt}$

D. Discharging Current of a Capacitor

Time (t)	Current $I_C(t) = C\dfrac{dv}{dt}$

5. Graphs

- Plot the graphs using graphing tools i.e., Excel or through any online resources.

A. Charging and Discharging Voltage of a Capacitor

B. Charging and Discharging Current of a Capacitor

6. % Error

- Compute the % error here.

7. Conclusion