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ASSIGNMENT 2

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Electrical Control Systems

BEng, HND & HNC Automotive, Motorcycle & Motorsport Engineering

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Table Of Contents

Contents

Task 3	1
Scope Time Division Calculations (3)	2
Function Generator output square wave (3)	3
Basic Capacitor Calculations (3)	4
Capacitor discharge table (2)	5
Plot $\log(V)$ Gradient (2)	5
Gradient Calculations and Compare (4).....	6
Gradient Calculations.....	6
Comparison table.....	6
Capacitor Uses (5)	6
Inaccuracies Question (4).....	7
References	8

Task 3

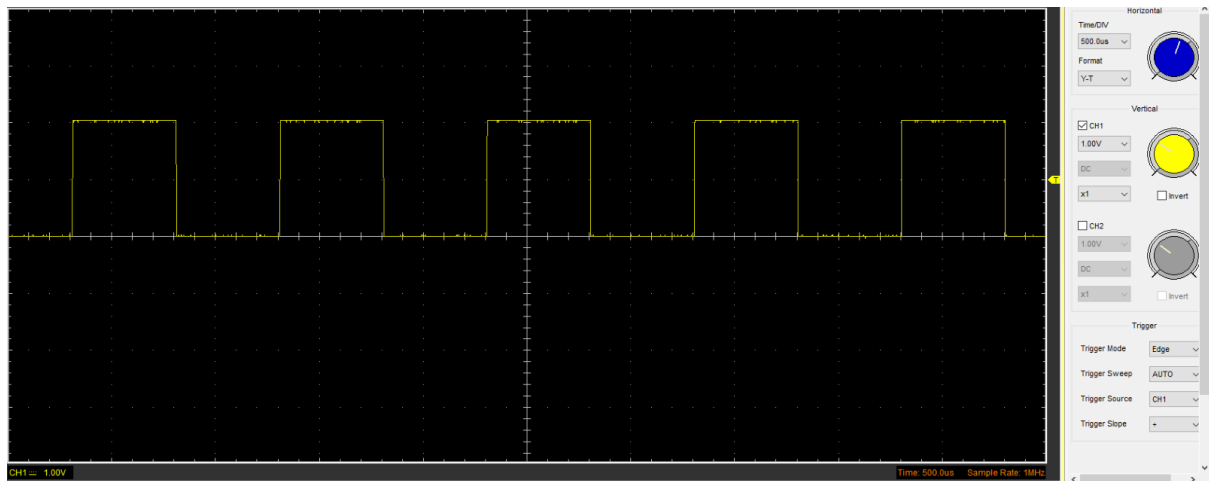
Scope Time Division Calculations (3)

$$\text{Time / Division} = \frac{\text{Period (T)}}{10}$$

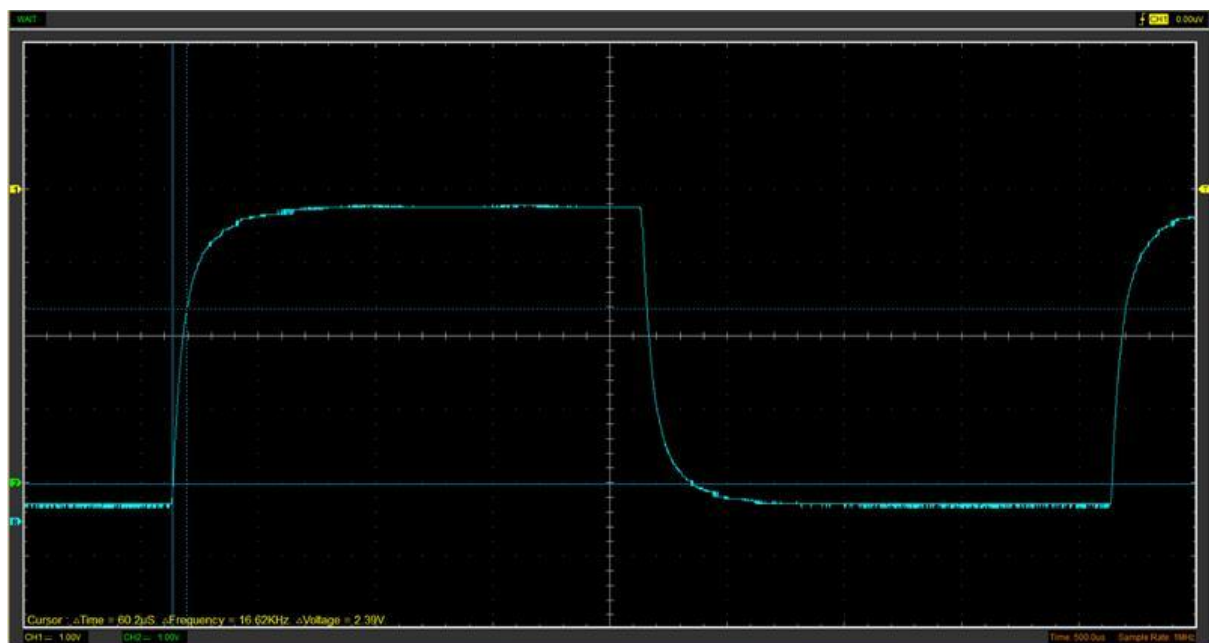
$$T = 40$$

$$\text{Time / Division} = \frac{40}{10} = 4 \text{ ms}$$

Function Generator output square wave (3)



Capacitor charge and discharge wave marked at correct points. (3)



Basic Capacitor Calculations (3)

$$\text{Maximum Voltage} = 3.79\text{V}$$

$$63.2\% \text{ Voltage} = \frac{3.79}{100} \times 63.2$$

$$63.2\% \text{ Voltage} = 2.39\text{V}$$

$$@ 2.39\text{V} : \text{Time Constant} = 60.2\mu\text{s}$$

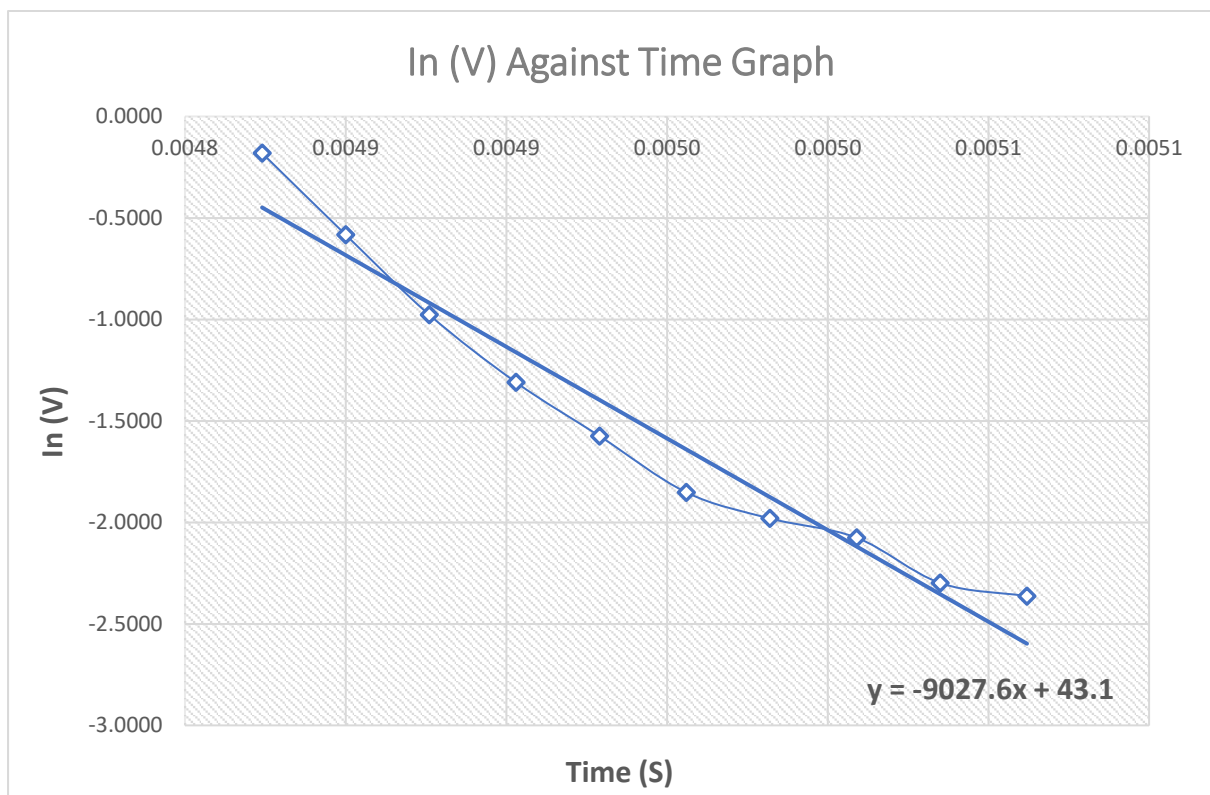
$$\tau = RC \quad \text{or} \quad C = \frac{\tau}{R}$$

$$\therefore \frac{60.2}{100} = 6.02 \times 10^{-7}$$

Capacitor discharge table (2)

Time (s)	Voltage (V)	ln (V)	$dy = y_2 - y_1$ $dy = \ln(V)_2 - \ln(V)_1$	$dx = x_2 - x_1$ $dx = \text{Time}_2 - \text{Time}_1$	dy/dx
0.0048	0.8345	-0.1809	x	x	x
0.0049	0.5584	-0.5827	-0.4018	0.000026	-15452.20
0.0049	0.3765	-0.9768	-0.3942	0.000026	-15159.90
0.0049	0.2698	-1.3101	-0.3332	0.000027	-12342.11
0.0049	0.2071	-1.5746	-0.2645	0.000026	-10172.28
0.0050	0.1569	-1.8521	-0.2776	0.000027	-10281.23
0.0050	0.138	-1.9805	-0.1284	0.000026	-4936.73
0.0050	0.1255	-2.0754	-0.0949	0.000027	-3516.59
0.0050	0.1004	-2.2986	-0.2231	0.000026	-8582.44

Plot log(V) Gradient (2)



Gradient Calculations and Compare (4)

Gradient Calculations

Comparison table

	Capacitance	Delta	Percentage difference
Actual	1 μF	X	X
Marker Calculation	0.62 μF	-0.38 μF	-38%
Gradient Calculation	1.108 μF	.108 μF	10.8%

Capacitor Uses (5)

Electrical Applications:

Capacitors smooth voltage in DC power supplies. This is achieved by when the voltage rises and discharging when it drops, ultimately filtering out unwanted AC ripple and providing a more stable DC output. (ElectronicBase, 2018)

Capacitors store electrical energy over a short period, they then release it rapidly, all at once to produce a quick, intense burst of light, demonstrated in camera flashes and other devices requiring high-power, short-duration energy release. (Cope, 2021)

Capacitors improve the efficiency of AC power systems by supplying reactive power to counteract the delayed current caused by inductive loads like motors and transformers. By providing reactive power, capacitors help reduce the phase difference between voltage and current, effectively balancing the power flow. (Leading Electronic Component Supplier from China | Weishielectronics, 2024)

Capacitors pass AC signals between circuit stages by supporting the alternating current to flow through, while blocking DC voltage. This prevents unwanted DC components from interfering with subsequent stages and helps maintain the stability of the circuit by avoiding voltage shifts. (Deane, 2024)

Capacitors charge and discharge through resistors at precise rates, which then control the timing in circuits like 555 timers. The capacitor's charging time determines the delay, allowing for exact timing intervals in various applications, such as generating pulses or creating delays. (Wilson, 2024)

Automotive Applications:

In CDI (Capacitor Discharge Ignition) systems, capacitors rapidly charge from a high-voltage source, then quickly discharge through the ignition coil to generate a high-voltage pulse that fires the spark plug. (Jason, 2015)

Capacitors help suppress EMI (Electromagnetic Interference) and RFI (Radio Frequency Interference) by providing a low-impedance path for high-frequency noise, redirecting it to ground and preventing it from affecting sensitive circuits. (TDK Electronics AG, 2025)

Capacitors stabilize voltage in ECUs (Electronic Control Units) and car audio systems by absorbing voltage spikes, ensuring a steady power supply to prevent system resets or malfunctions. (Tomáš Zedníček, 2019)

Motorcycle Applications:

Capacitors smooth out voltage fluctuations in LED lighting circuits by storing and releasing energy, ensuring a steady power supply and preventing flickering caused by unstable or alternating current. (Miktecprep, 2021)

Capacitors in motorcycle dashboards and instrument clusters stabilize voltage by filtering power fluctuations, ensuring a steady supply to digital displays and sensors, and preventing malfunctions or display errors. (Bianchini, 2017)

Inaccuracies Question (4)

Regular calibration of measuring instruments is crucial to maintaining accurate results. Over time, instruments can experience wear and tear or environmental factors that cause them to move away from their original calibration settings. Consistent calibration ensures that the instruments continue to provide reliable data, helping to avoid discrepancies. (D+M, 2024)

Furthermore, physically handling capacitors during measurement can have a major impact on their performance. When capacitors are incorrectly handled or exposed to excessive force, they can become physically deformed, which may change their internal structure. As a result, measurements taken under these conditions may not accurately reflect the capacitor's true specifications, leading to faulty data and unreliable results. (DATAMYTE, 2022)

Finally, the technique of the operator also plays a significant role in the accuracy of measurements. Variations in how measurements are taken, such as differences in the method of connecting the test equipment to the capacitor, can introduce inconsistencies. For instance, small differences in how probes are positioned, how tightly they make contact, or how the readings are interpreted can all affect the final results. (Keyence.co.uk, 2025)

Overall, Understanding and controlling these factors is important for accurate capacitor measurements and ensuring reliable electronic component performance.

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