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Electronic Circuits Testing and Applications

ACHA4040

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1 Task 1

1.1 A

$$0.6V/0.5A = 1.2\Omega$$

1.2 B

$$0.5A - 0.3A = 0.2A$$

$$0.2A/2 = 0.1A$$

$$-0.3A - 0.1A - 0.1A + 0.5A = 0$$

1.3 c (i)

$$E = R * I^2 * T$$

$$A = 10\Omega = \frac{0.9}{0.3^2 * 1}$$

1.4 c (ii)

$$3V = 0.3 * 10$$

$$3V/0.1A = 10\Omega$$

Resistance of B and C = 30 Ω

1.5 c (iii)

$$\frac{1}{\frac{1}{10} + \frac{1}{30} + \frac{1}{30}} = 6\Omega$$

$$\text{Drop A, B, C} = 3V = 6\Omega / 0.5A$$

1.6 c (iv)

$$5V - 3V - 0.6V = 1.4V$$

$$D = 1.4/0.5 = 2.8\Omega$$

1.7 d

$$2V/0.5A = 4\Omega - 1\text{ cell}$$

$$R_t = \frac{1}{\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4}} = 1\Omega$$

1.8 e

$$6 * 0.5 = 3V$$

1.9 f

$$0.875V$$

Student Name

Assignment Title or Module

Student Number

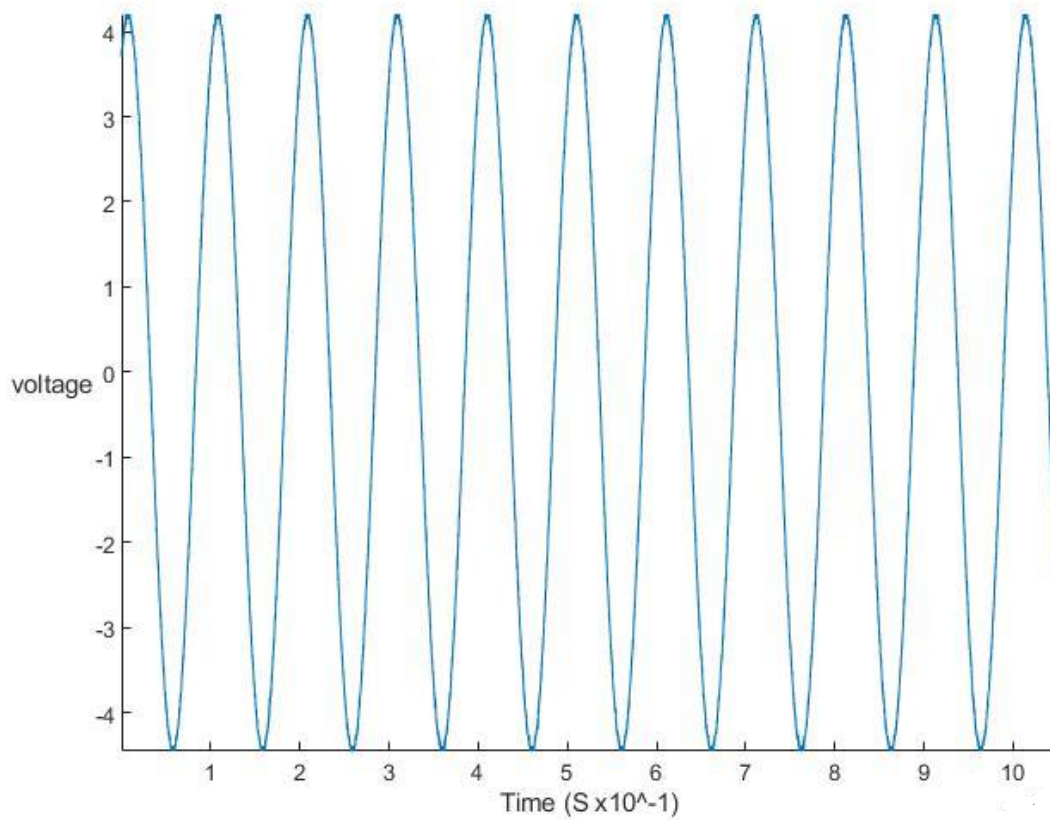
1.10 g

2 Task 2

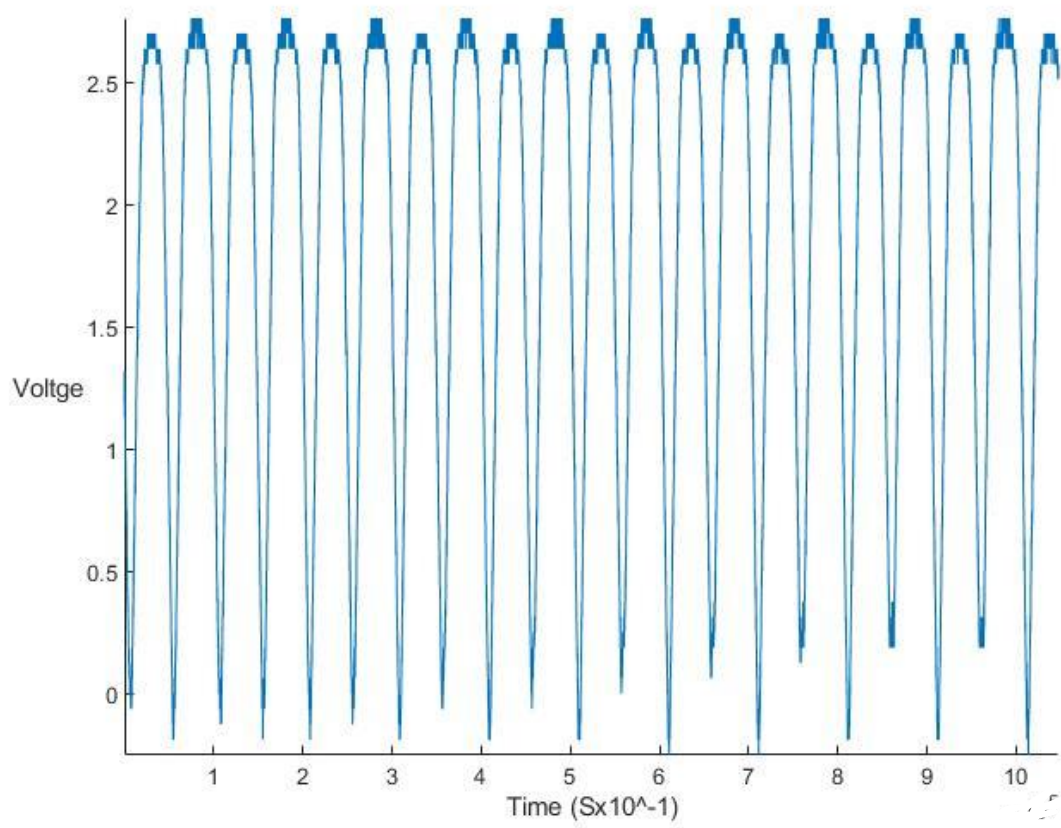
2.1 Scope Time Division Calculations

$$Period = \frac{1}{f} \text{ Therefore } Period = \frac{1}{10} = 0.1$$

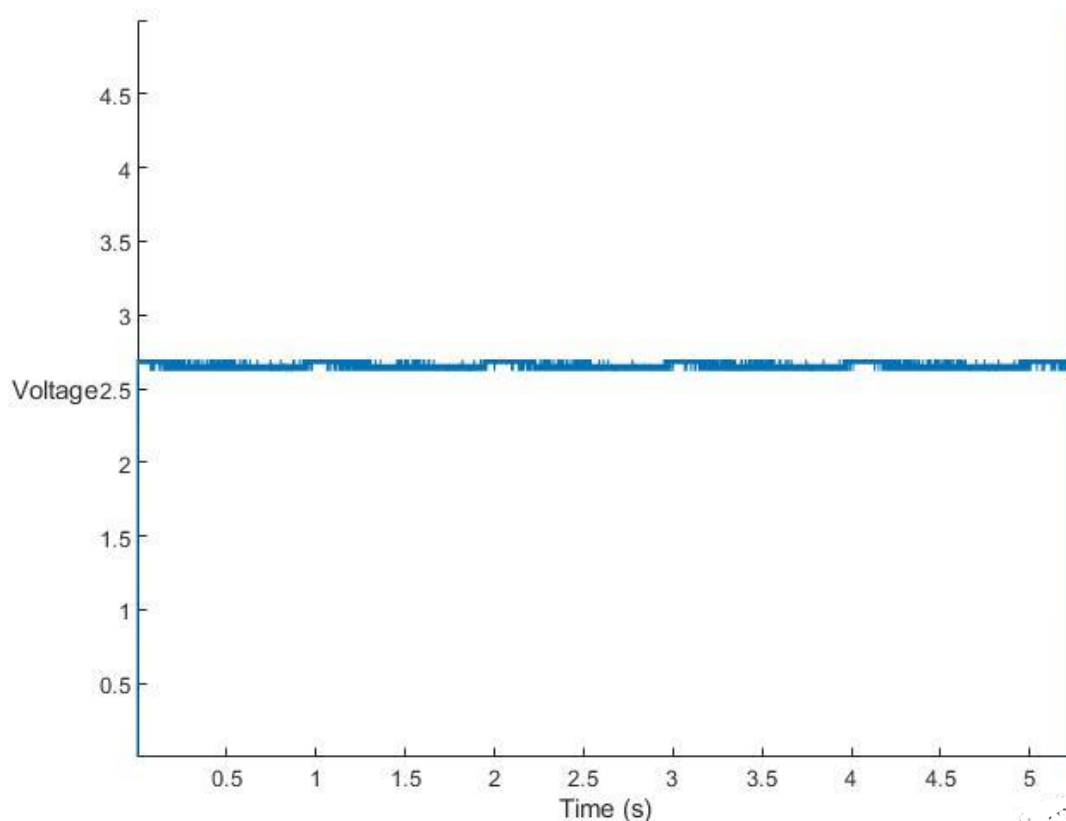
2.2 Function Generator output sine wave



2.3 Unsmoothed Rectifier Wave



2.4 Smoothed Rectifier Wave



2.5 Drop in Voltage Question

The diode voltage drop is one of the main factors that causes the DC output of the rectifier to be lower than the peak of the sinewave input. When a diode is forward-biased and conducts current, it has a voltage drop across it that reduces the voltage available at the output. This voltage drop is typically around 0.7V for silicon diodes.

2.6 Rectifiers use in Automotive applications Question.

Alternators in modern cars produce AC voltage, which is then rectified to DC voltage by a bridge rectifier. The rectifier is a key component of the vehicle's charging system, as it provides the DC voltage needed to charge the battery and power the electrical system while the engine is running.

2.7 Probing Question

When using an oscilloscope, all signals are referenced to the same ground, which means that all signals share the same ground potential. If the function generator and rectifier are not grounded to the same potential, this can cause issues with measurement accuracy.

To allow simultaneous probing of both signals while avoiding these issues, you can use an oscilloscope with isolated channels or an isolation amplifier. An oscilloscope with isolated channels allows you to measure two signals that are not grounded to the same potential, as each channel is isolated from the other. An isolation amplifier, on the other hand, can be used to isolate the signals from each other and provide a reference ground that is common to both signals, allowing simultaneous probing without any issues.

3 Task 3

3.1 Scope Time Division Calculations

The calculation for one time constant is,

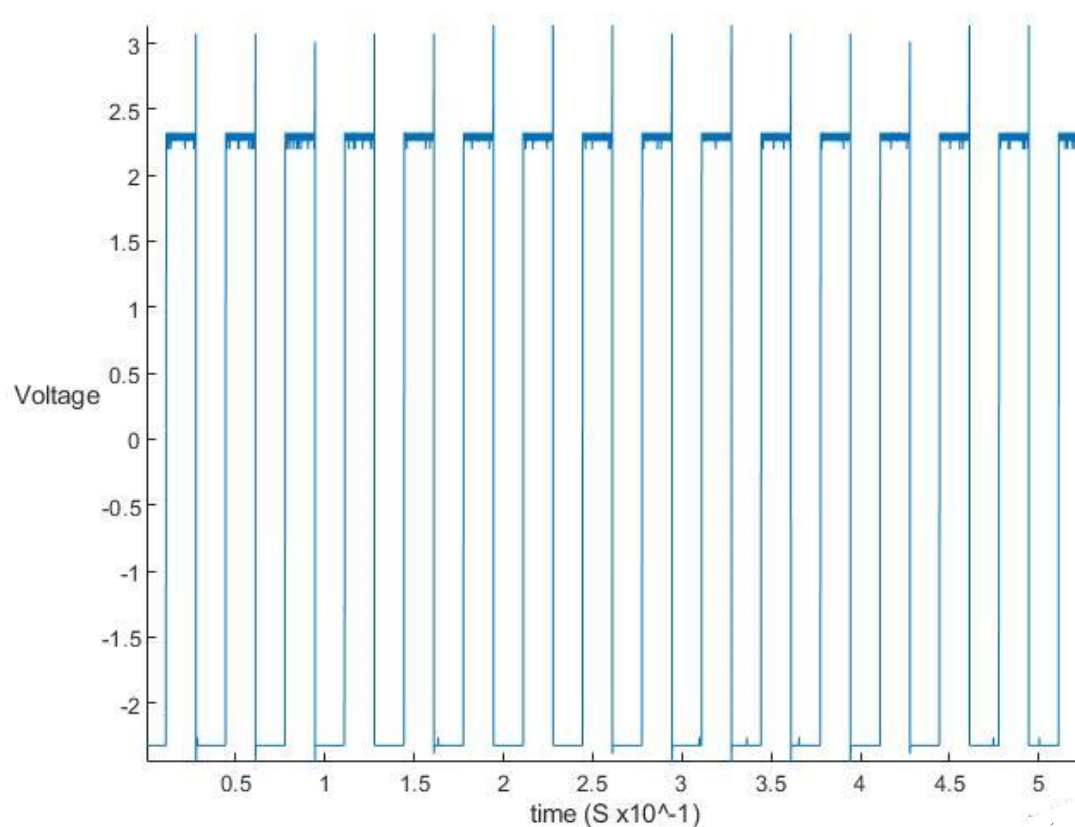
$$T = RC$$

To show a fully charged or discharged capacitor a period of 20 time constants has been selected. This period must be at least 0.0001s, or the period of 10kHz.

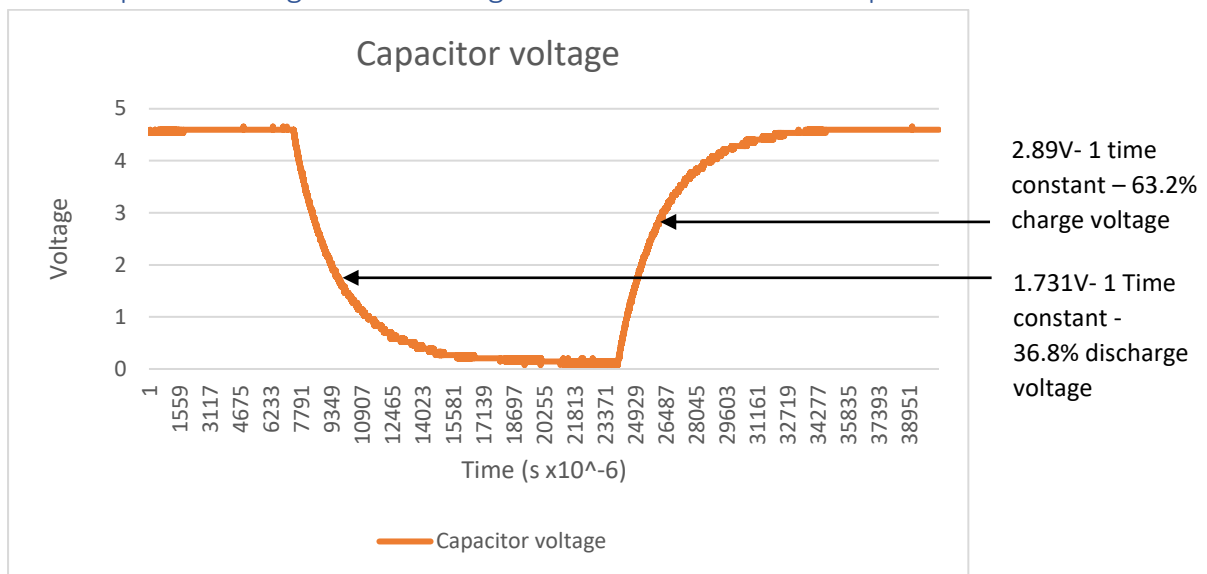
With the 0.22uF Capacitor and 10K resistor the time for one time constant of 0.0022s, or 0.044s for 20 time constants.

This gives our minimum frequency to be 22.72hz. 30hz was used, which was silly

3.2 Function Generator output sine wave



3.3 Capacitor charge and discharge wave marked at correct points.



3.4 Basic Capacitor Calculations

Start voltage – 4.58V

63.2 % discharge – 1.73v

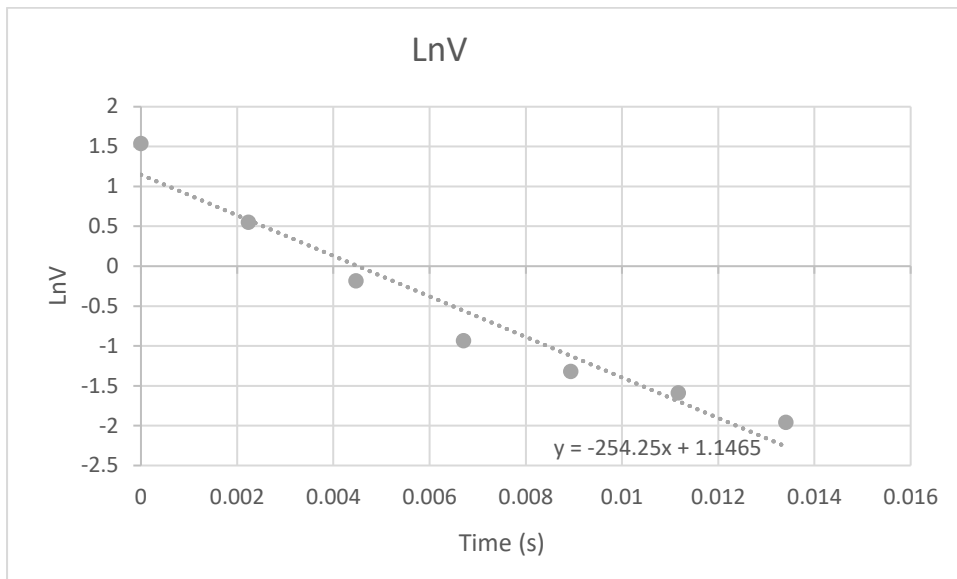
time for one time constant – 2234x10⁻⁶

As $C = \frac{T}{R}$ then the capacitance would equal 0.2234 μF

3.5 Capacitor discharge table

t (sx10 ⁻⁶)	0	0.002234	0.004468	0.006702	0.008936	0.01117	0.013404	0.015638	0.01787
V	4.6588	1.73139	0.8314	0.3922	0.2667	0.2039	0.1412	0.1412	2.14
LnV	1.538758	0.548925	-0.18464	-0.93598	-1.32163	1.59013	-1.95758	-1.95758	0.76500

3.6 Gradient Plot and calculations



As $c = \frac{1}{R \cdot \text{Gradient}}$ the capacitance can be calculated to be $0.396\mu\text{F}$

This is a difference of 0.1726 or 77%

3.7 Inaccuracies Question

There are several reasons why the calculated capacitance from measurements taken using an oscilloscope, capacitor, and resistor may vary from the specified value. One possible reason is the presence of parasitic capacitance and inductance in the measurement setup, which can affect the accuracy of the measurement. Parasitic capacitance refers to capacitance that exists between the capacitor being measured and other conductive components in the measurement setup, such as wires or the oscilloscope probes. Similarly, parasitic inductance can be present in the form of wires and other components in the circuit.

Another reason for measurement variation can be due to the inherent limitations of the measurement instruments themselves. Oscilloscopes, while highly precise instruments, have limitations in terms of their sensitivity and frequency response. Inaccuracies can also arise due to the resistance and capacitance values used in the measurement circuit, as small differences in these values can result in significant changes in the calculated capacitance.

Other factors that can affect the accuracy of capacitance measurements include variations in temperature, humidity, and other environmental factors, as well as the quality of the capacitor itself. Some capacitors may have manufacturing defects or may degrade over time due to environmental factors, which can impact their performance.