Sample Data no calculations

Name: Genna Crom Date: Spring 2023

Instructor: Carlos Lopez Carrillo

Teammates

1.- David Frothingham 2.- ____

3.- ____ 4.- ____

Instructions: Follow the steps on this worksheet, using your lab manual as a guide, unless directed to do otherwise by your lab instructor. Show at least one sample calculation for each step. Box final mathematical results. Do not forget the units.

$f = 30\,kHz$

$V_{pp} = 6V$

Data

Measure the period of the input signal, and the actual values of Resistance, and Capacitance. Record your values in Table 1.

Table 1.- Parameters

Resistance (Ω)	Capacitance (F)	Signal's Period (s) (s)	Angular Freq. (rad/)
$R =$ 32.25 kΩ	$C =$ 108.8 pF	$T =$ 33.33 μs	$\omega =$

Measure the peak-to-peak voltage drop across the resistor and capacitor for each of the input voltages listed in Table 2. Record your values in the same table.

Table 2.- Voltage Drops

$\Delta V_{s\,p-p}$ (V)	$\Delta V_{R\,p-p}$ (V)	$I_{con\,p-p}$ (A)	$\Delta V_{C\,p-p}$ (V)	$I_{dis\,p-p}$ (A)
6V	2.6V		4.2V	
8V	3.6V		5.6V	
10V	4.4V		7.0V	
12V	5.4V		8.4V	
14V	6.2V		9.8V	
16V	7.0V		11.2V	
18V	8.0V		12.6V	

Sample Data & calculations included

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$f = 30\,kHz$

$V_{pp} = 6V$

Data

Measure the period of the input signal, and the actual values of Resistance, and Capacitance. Record your values in Table 1.

Table 1.- Parameters

Resistance (Ω)	Capacitance (F)	Signal's Period (s)	Angular Freq. (rad/s)
$R = 32.25\,k\Omega$	$C = 108.8\,pF$	$T = 33.333\,\mu s$	$\omega = 1.885\times10^5$ rad/s

Measure the peak-to-peak voltage drop across the resistor and capacitor for each of the input voltages listed in Table 2. Record your values in the same table.

Table 2.- Voltage Drops

$\Delta V_{s\,p-p}$ (V)	$\Delta V_{R\,p-p}$ (V)	$I_{con\,p-p}$ (A)	$\Delta V_{C\,p-p}$ (V)	$I_{dis\,p-p}$ (A)
6V	2.6V	80.62 μA	4.2V	86.14 μA
8V	3.6V	111.63 μA	5.6V	114.85 μA
10V	4.4V	136.43 μA	7.0V	143.56 μA
12V	5.4V	167.44 μA	8.4V	172.27 μA
14V	6.2V	192.25 μA	9.8V	200.99 μA
16V	7.0V	217.05 μA	11.2V	229.70 μA
18V	8.0V	248.06 μA	12.6V	258.41 μA

Analysis

1. Determine the angular frequency of the input signal and record it in Table 1.

$\omega = 2\pi f = 1.885 \times 10^5$ rad/s   rad/s

2. For each voltage drop across the resistor, determine the peak-to-peak value of the conduction current (use Ohm's law). Show here a sample calculation, and record all your results in Table 2.

$V = IR \Rightarrow I = \frac{V}{R} = \frac{2.6\,V}{32.25 \times 10^3\,\Omega} = 8.06 \times 10^{-5}\,A$

i.e. $80.6\,\mu A$

3. For each voltage drop across the capacitor, determine the peak-to-peak value of the displacement current. Show here a sample calculation, and record all your measurements in Table 2.

Hence, the amplitude of the displacement current is

$$I_{d0} = C\omega V_{c0}$$

$I_D = (108.8 \times 10^{-12}\,F)(1.885 \times 10^5\,\frac{rad}{s})(4.2V) = 86.14\,\mu A$

4. In the space provided for Figure 1, make a plot of the displacement current against the conduction current.

5. Fit a straight line to your data and determine its slope.

slope = 1.044

6. What should be the value of the slope of the fitted line? Why?

The slope should equal 1, meaning $I_D = I_R$ and current is conserved throughout the circuit.

7. Compare the actual value of your fitted line to the expected value.

$\text{Error} = \frac{1.044 - 1}{1.044} = \boxed{4.21\%}$

In [2]:

```
import numpy as np
import matplotlib.pyplot as plt
```

In [12]:

```
Id=np.array([86.14,114.85,143.56,172.27,200.99,229.70,258.41])
Ir=np.array([80.62,111.63,136.43,167.44,192.25,217.05,248.06])
a,b= np.polyfit(Ir,Id,1)
plt.scatter(Ir,Id)
plt.plot(Ir,a*Ir+b)
plt.text(100,225,"slope=%f"%a)
plt.xlabel("Conduction Current [micro A]")
plt.ylabel("Displacement Current [micro A]")
plt.title("Displacement vs Conduction Current")
plt.show()
```