جامعة بيرزيت
BIRZEIT UNIVERSITY

Physics Department

Physics 112

Experiment 9: Resonance

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Abstract:

The aim of experiment is to study the effect of resistance on the bandwidth and quality factor, and calculate the resonance frequency.

The results are: when R = 1KΩ: $f_{resonance} = 5\ KHz$.

Bandwidth = $1.09 * 10^5\ rad/s$

Quality factor = 0.316

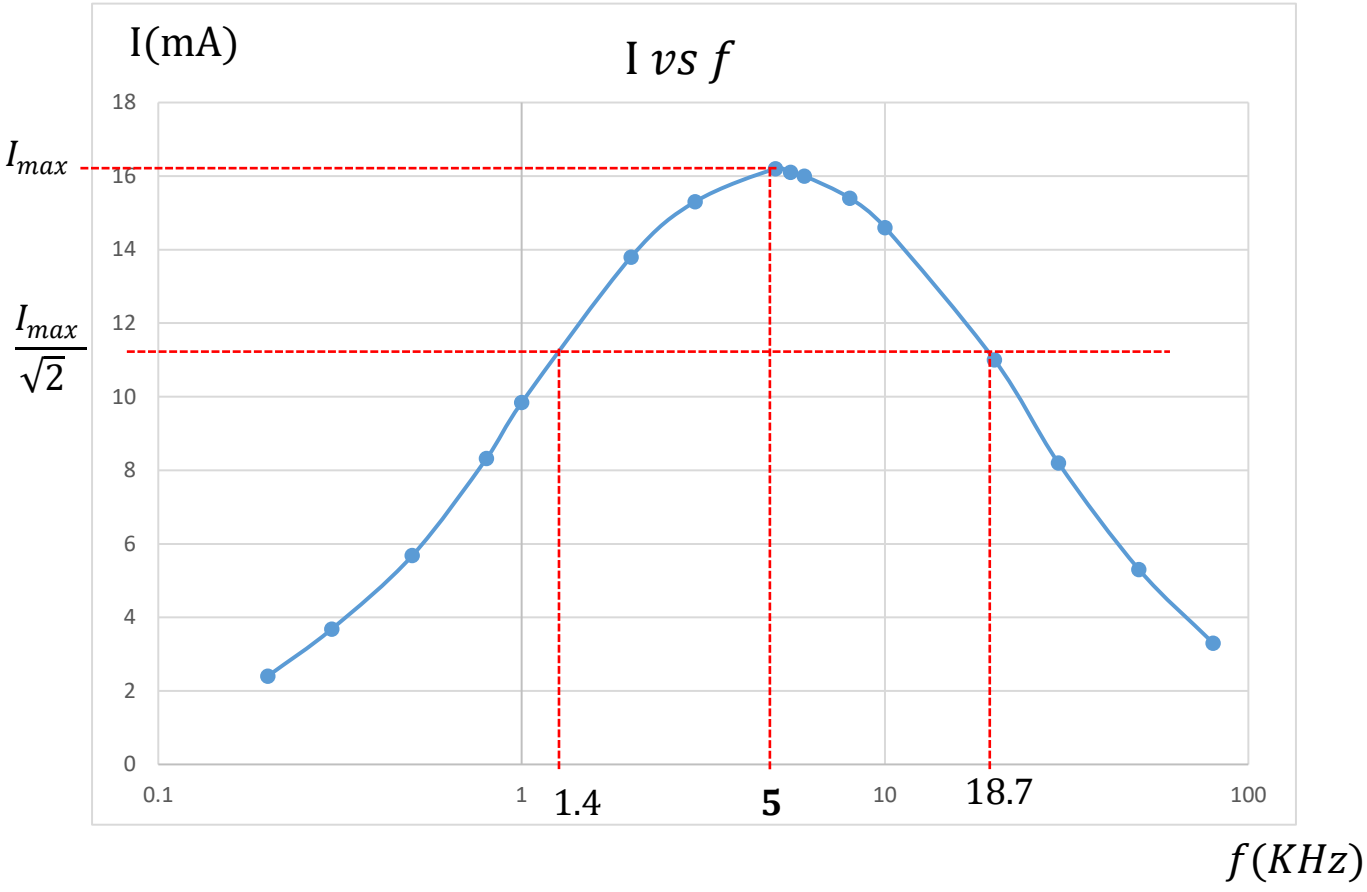
When R = 2KΩ: $f_{resonance} = 5\ KHz$.

Bandwidth = $1.8 * 10^5\ rad/s$

Quality factor = 0.172

Calculations:

GRAPH 1: when R = 1 KΩ: -



From the graph:

$I_{max} = 16.2\ mA$,,,, $and\ the\ resonance\ frequency\ is\ 5\ KHz$

And $\frac{I_{max}}{\sqrt{2}} = \frac{16.2}{0.707} = 11.455\ mA$, we see the points that intersect this line (we use desmos to find these points) .these points are the limits of the term which called bandwidth of the frequency.

Theoretically:

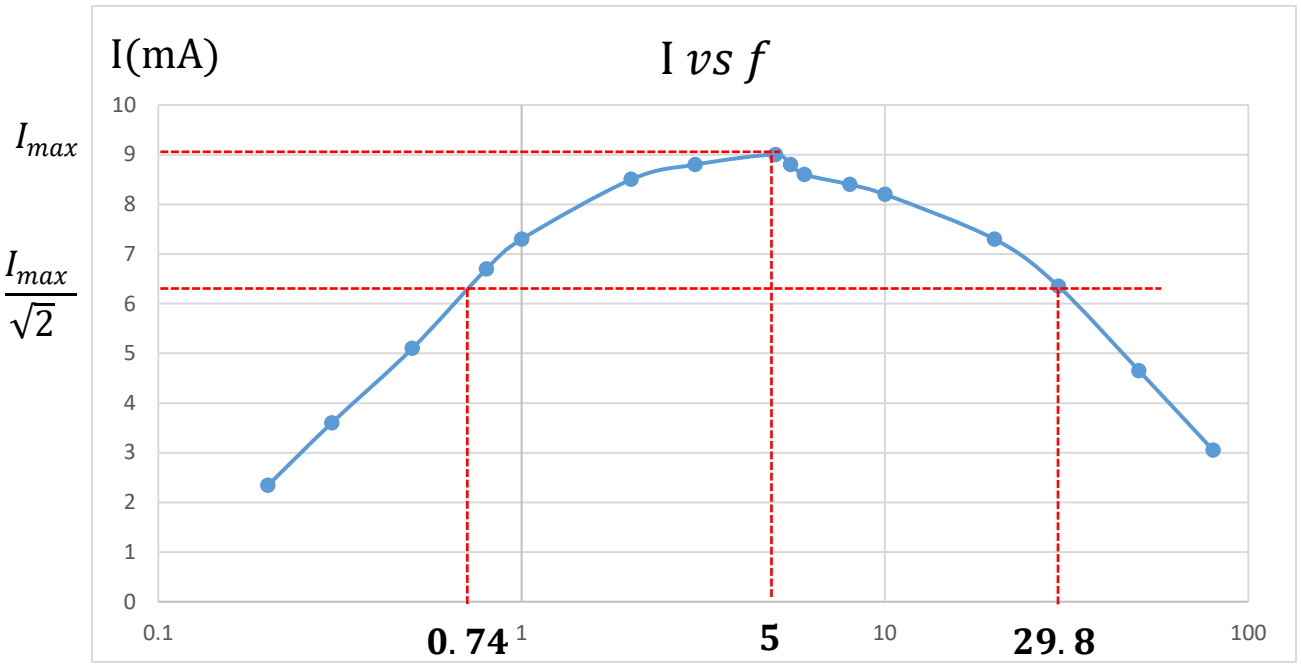
Quality factor = $\frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{1000}\sqrt{\frac{10*10^{-3}}{0.1*10^{-6}}} = 0.316$

Experimentally:

Bandwidth = $\Delta\omega = 2\pi\Delta f = 2\pi\ (18.7 - 1.4) * 1000 = 1.09 * 10^5\ rad/s$

Quality factor = $\frac{f_{resonance}}{\Delta f} = \frac{5}{18.7-1.4} = 0.289$

GRAPH 2: when R = 2 KΩ: -



From the graph:

$I_{max} = 9\ mA$,,,, $and\ the\ resonance\ frequency\ is\ 5\ KHz$

And $\frac{I_{max}}{\sqrt{2}} = \frac{9}{0.707} = 6.36\ mA$, we see the points that intercect this line (we use desmos to find these points) .these points are the limits of the term which called bandwidth of the frequency.

Theoretically:

Quality factor = $\frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{2000}\sqrt{\frac{10*10^{-3}}{0.1*10^{-6}}} = 0.158$

Experimentally:

Bandwidth = $\Delta\omega = 2\pi\Delta f = 2\pi\ (29.8 - 0.74) * 1000 = 1.8 * 10^5\ rad/s$

Quality factor = $\frac{f_{resonance}}{\Delta f} = \frac{5}{29.8-.74} = 0.172$

Results and conclusion:

This experiment discussed how to find the resonance frequency and quality factor of an I vs ω graph, at two different values of resistance. It was discovered that at R=1KΩ graph displayed a resonance frequency equal to 5 KHz, with a quality factor at 0.289. While the theoretical value is 0.316, these experimental values had a large percentage error when relating it to the theoretical values. As for when R was equal to 2KΩ the graph, it displayed a resonance frequency equal to 5KHz too with a quality factor 0.172 while the theoretical value is 0.158, and in this case the two values are closer to each other, we can conclude that The Quality factor for the different resistors is inversely proportional to the resistance of the circuit.