PHYSICS PRACTICAL SHEETS

Date 29 August 2023 ..... KU ..... CAMPUS
Class CE
Roll No. 25
Shift Day
Object of the Experiment (Block Letter)

Experiment No. 7
Group T
Sub. PHY102
Set

STUDY OF PHENOMENON OF RESONANCE IN PARALLEL LCR CIRCUIT

Apparatus Required:
i) Frequency generator ii) Inductor and resistor iii) Capacitor box
iv) Multimeter v) AC supply.

Theory

The impedence Z for parallel LCR circuit is

$$Z = \frac{[R + i\omega(L(1-\omega^2LC) - CR^2)]}{[(1-\omega^2LC)^2 + \omega^2R^2C^2]}$$

where, $Z = |Z|e^{i\theta}$ is complex quantity.
$|Z|$ = impedence of circuit θ = phase difference bet^n voltage & I
It can be shown that,

$$\tan\theta = \omega[L(1-\omega^2LC) - CR^2]/R$$

The impedence as well as the phase difference bet^n source voltage and current depends on frequency. At resonant frequency, $f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$, the impedence becomes maximum resulting minimum current in circuit.

When R is small then, $1/LC >> R^2/L^2$ and Hence,

$$f_0 = \sqrt{\frac{1}{LC}} \times \frac{1}{2\pi}$$

Let us consides a slightly modified // circuit with high resistance R_S ($R_S >> Z$) connected to the source in series. Keeping the source voltage constant (V_{rms}), the impedence Z of the // circuit changes resulting the change in current in the circuit. Since $R_S >> Z$, the change in current due to change in impedance is negligibly small. It turns out that with change in frequency, the I_{rms} in the circuit remains almost constant but the voltage across the LC parallel changes.

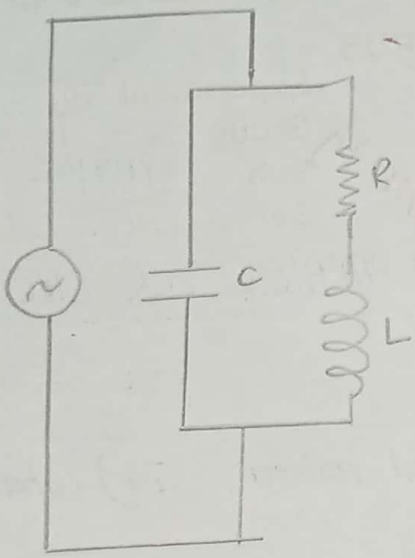

Fig: Diagram of LCR with AC source.

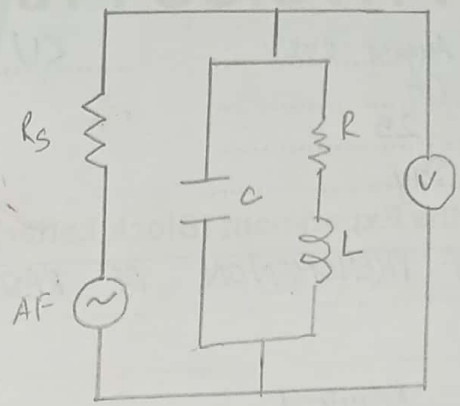

Fig: Diagram of LC circuit with AC source with high resistance in series.

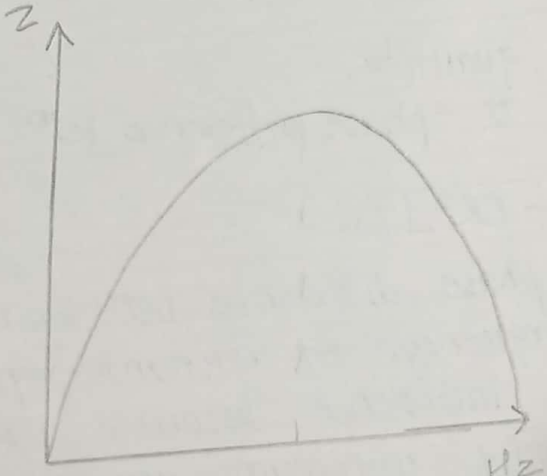

Fig: Z vs Hz graph

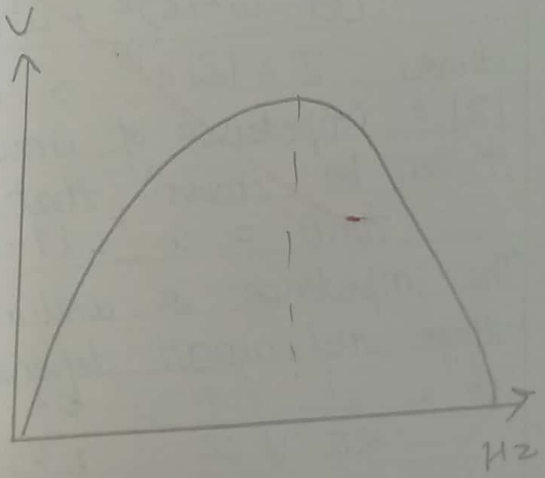

Fig: Z vs Hz graph

Observations:

No of obs	$C_1 = 0.1\,\mu F$		$C_2 = 0.22\,\mu F$		$C_3 = 0.33\,\mu F$	
	f (Hz)	V (voltage)	f (Hz)	V (voltage)	f (Hz)	V (Voltage)
1.	0	0	0	0	0	0
2	1000	0.9	1000	1	1000	1.1
3	2000	1.8	2000	2.2	2000	2.5
4	3000	2.5	3000	3.05	3000	2.7
5	4000	3.1	4000	3.1	3200	2.6
6	5000	3.6	4400	2.9	3600	2.35
7	6000	3.65	4800	2.55	4000	2.05
8	6600	3.7	5000	2.4	5000	1.35
9	7000	3.6	6000	1.75	6000	0.85
10	7200	3.4	7000	1.2	7000	0.55
11	8000	3.1	8000	0.8	8000	0.53
12	9000	2.4	9000	0.6	9000	0.32
13	10000	1.9	10000	0.4	10000	0.1
14	11000	1.4	11000	0.3	11000	0.1
15	12000	1.1	12000	0.2	12000	0
16	13000	0.8	13000	0.1		
17	14000	0.6	14000	0.1		
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x) Calculation of induction:

No of obs	Capacitance (MF)	Resonant frequency (Hz)	Inductance (mH)
1	0.1	6600	5.81
2	0.22	4000	7.19
3	0.33	3000	8.52

∴ Mean inductance (H) = 7.17 mH

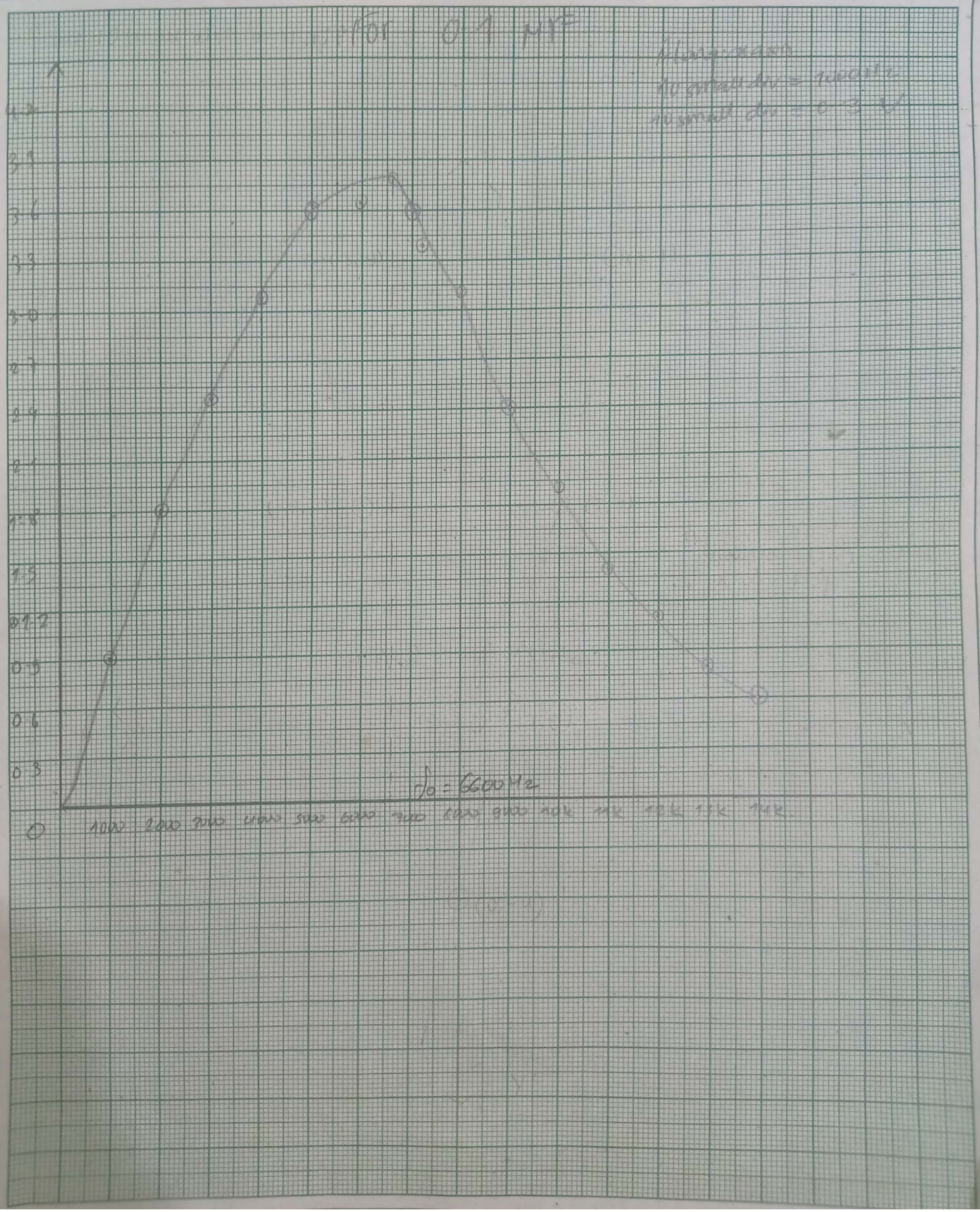
(ix) Result:

The value of the given inductor is 7.17 mH.

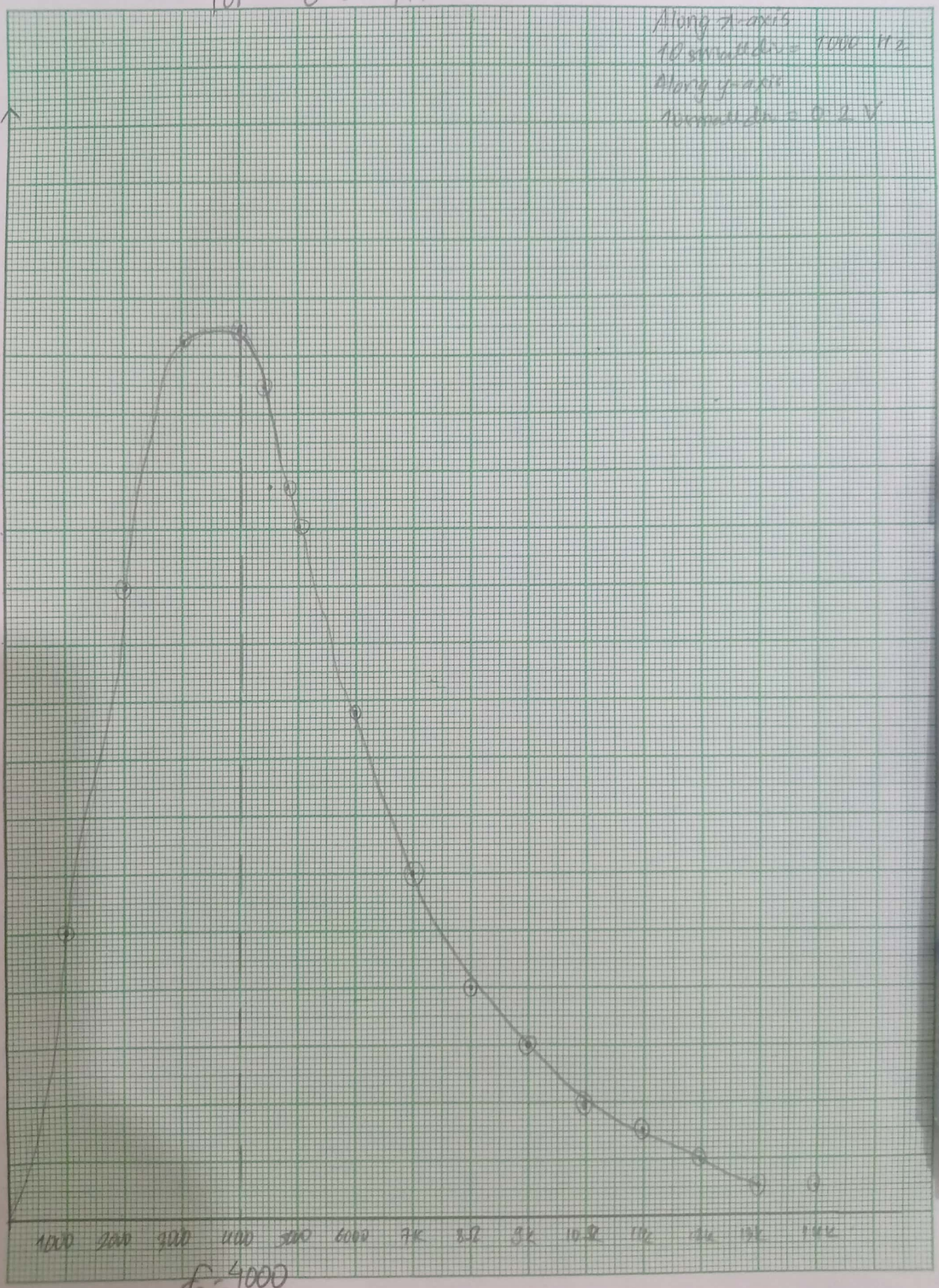
(x) Precautions:

i) Circuit connection must be well checked before joining the AC supply.
ii) The connecting wires should be checked using multimeter.

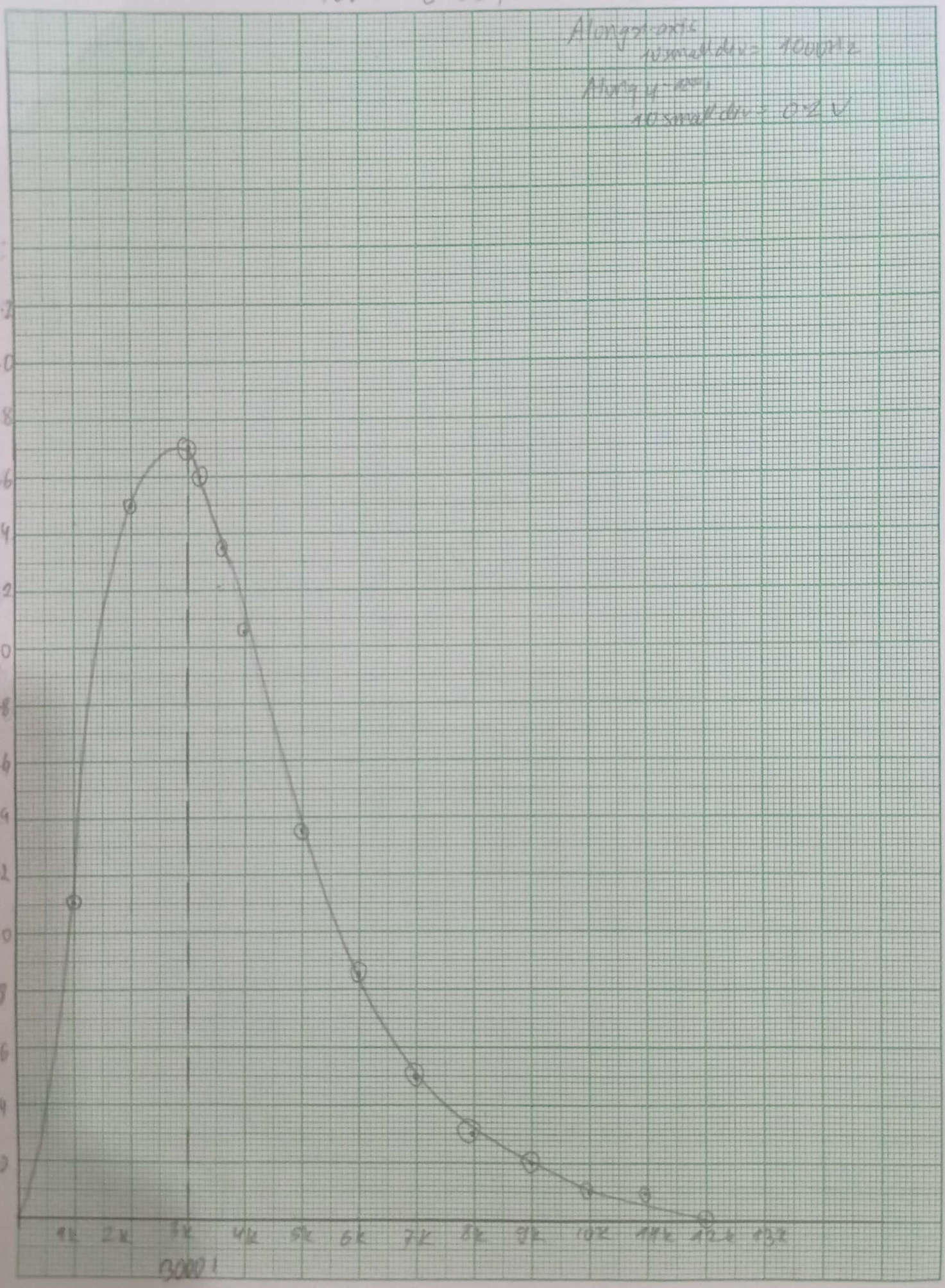
1.



For 0·22 μF


Along x-axis
10 small div = 1000 Hz
Along y-axis
1 small div = 0.2 V
3·4
3·2
3·0
2·8
2·6
2·4
2·2
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
1000
2000
3000
4000
5000
6000
7K
8K
9K
10K
11K
12K
13K
14K
$f_0 = 4000$

for 0·33 μF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0·8
0·6
0·4
0·2
1k
2k
3k
4k
5k
6k
7k
8k
9k
10k
11k
12k
13k
3000 Hz