سامر رضا,   Experiment 9

Resonance

* $\quad I(t) = \dfrac{\mathcal{E}(t)}{Z_{eq}}$

Amplitude

$I_0 \cos(\omega t + \phi) = \dfrac{\mathcal{E}_0 \cos(\omega t + \phi)}{Z_{eq}}$

$$I_0 = \dfrac{\mathcal{E}_0}{Z_{eq}} = \dfrac{\mathcal{E}_0}{\sqrt{R^2 + \left(\omega L - \dfrac{1}{\omega c}\right)^2}}$$

I_0 : the amplitude of the current passing through the circuit.

* I_0 has a maximum value when $\omega L - \dfrac{1}{\omega c} = 0$

$\Rightarrow \quad \omega L = \dfrac{1}{\omega c} \qquad \Rightarrow \quad \omega^2 = \dfrac{1}{LC} \qquad \Rightarrow \boxed{\omega_0 = \dfrac{1}{\sqrt{LC}}}$

ω_0 : the natural angular frequency of the circuit

ماذا يعني

* The current in the circuit assumes its maximum value when the driving voltage frequency equals the natural frequncy of the RLC circuit. This phenomenon is called resonance.
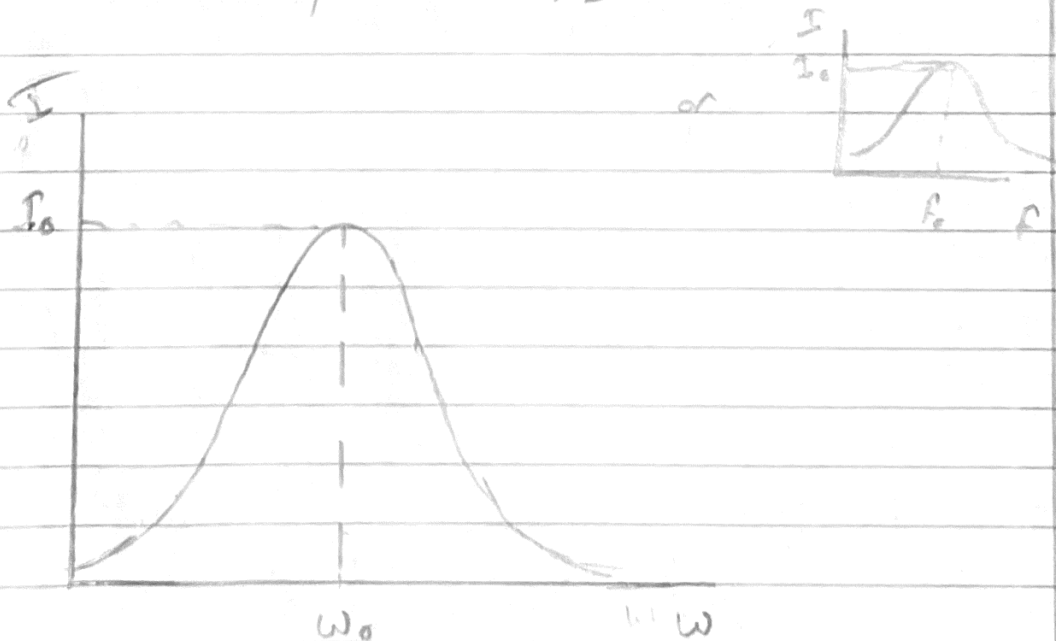
=) At resonance $\quad WL - \dfrac{1}{WC} = 0$

=) $\boxed{I_o = \dfrac{\varepsilon_o}{R}}$

In other word Resonance is a phenomenon that ocaures when the reastance of the capacitor and inductor is the same.

$W_o = \dfrac{1}{\sqrt{LC}}$ (Resonance frequncy)

driving voltage

b) natural frey from RLC circuit

or

$\dfrac{I}{I_o}$

$f_o \quad f$

I_o

W_o $\qquad$ W

Log

④

سلامكم ايضاً

✱ The quality Factor (Q) : A measure of the Sharpness of the resonance curve

كلما زادت تكون Q كلما زاد الـ Sharpness والتكون أكبر

$$\boxed{Q = \frac{WL}{R}} \quad \text{but} \quad w = \frac{1}{\sqrt{LC}} \quad \text{at resonance}$$

$$Q = \frac{1}{\sqrt{LC}} \frac{L}{R}$$

$$\Rightarrow \boxed{Q = \frac{1}{R}\sqrt{\frac{L}{C}}} \qquad (\text{Theo}) \\ \text{القيمة النظرية؟}$$

✱ Experimentally

$$I_0 = \frac{\varepsilon}{R}$$

$$I_{rms} = \frac{I_0}{\sqrt{2}} = 0.7 I_0$$

هو التيار الذي يكون مؤثر؟
الطاقة الم�, DC مؤثر
وكمية الطاقة المؤثر, AC

$w_1 \quad w_0 \quad w_2 \qquad\qquad w$

$\Delta w :$ bandwidth

$$Q = \frac{w_0}{|\Delta w|}$$

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or

$$P = \frac{f_0}{\Delta f}$$
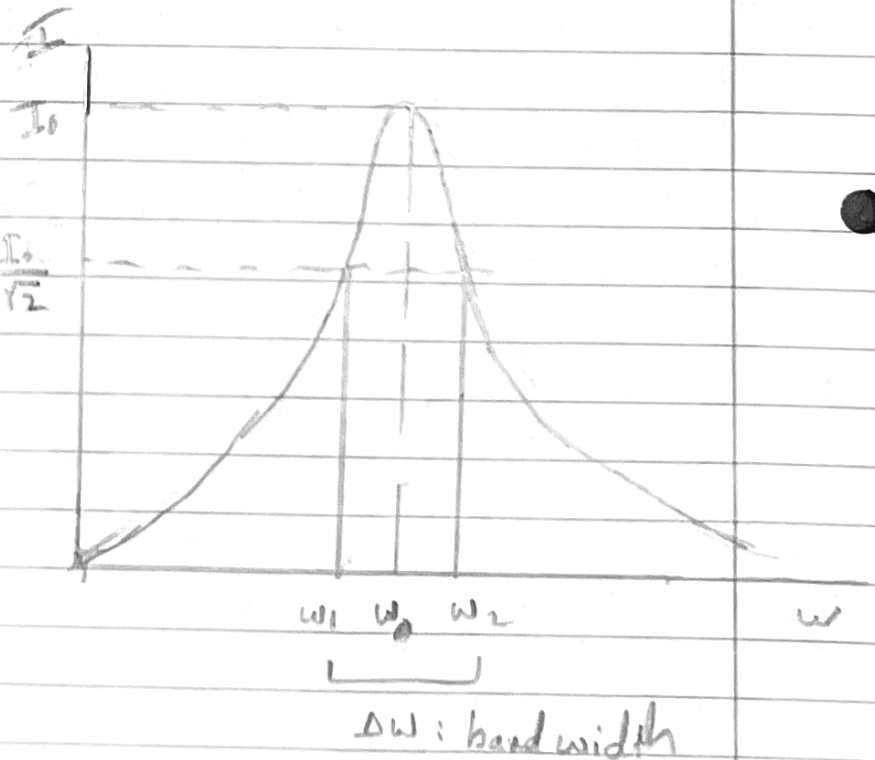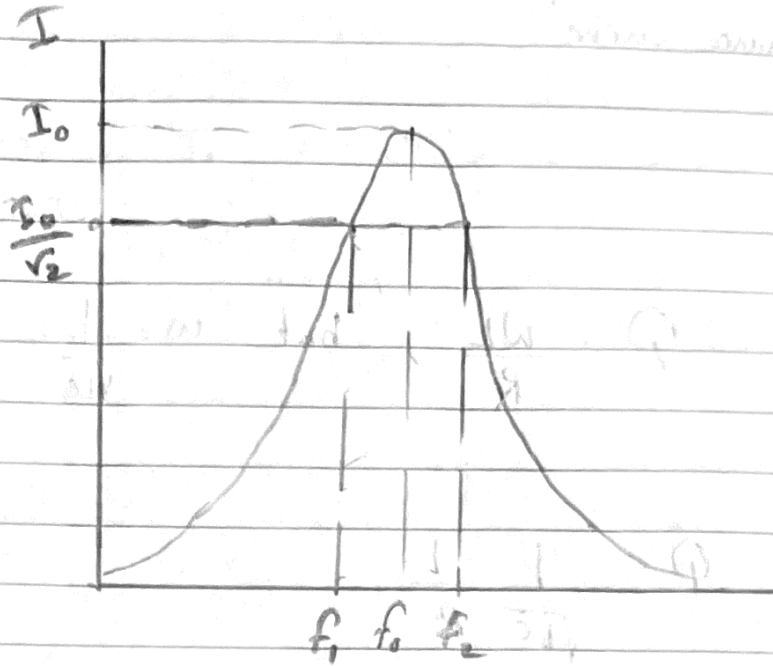
$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

Just at resonance
$$\left(Q = \frac{wL}{R} \quad , \quad w = w_o = \frac{1}{\sqrt{LC}} \right)$$
$$\left(Q = \frac{1}{R}\sqrt{\frac{L}{C}} \right)$$

$$Q \propto \sqrt{\frac{L}{C}} \implies Q \text{ is directly proportional to } \sqrt{\frac{L}{C}}$$

Sharpness الـ زاد كلما Q زادت كلما $\sqrt{\frac{L}{C}}$ زادت كلما

$$I_o$$
$$\left[\sqrt{\frac{L}{C}}\right]_1$$
$$\left[\sqrt{\frac{L}{C}}\right]_2$$

$$\left[\sqrt{\frac{L}{C}}\right]_2 > \left[\sqrt{\frac{L}{C}}\right]_1$$

$$w$$
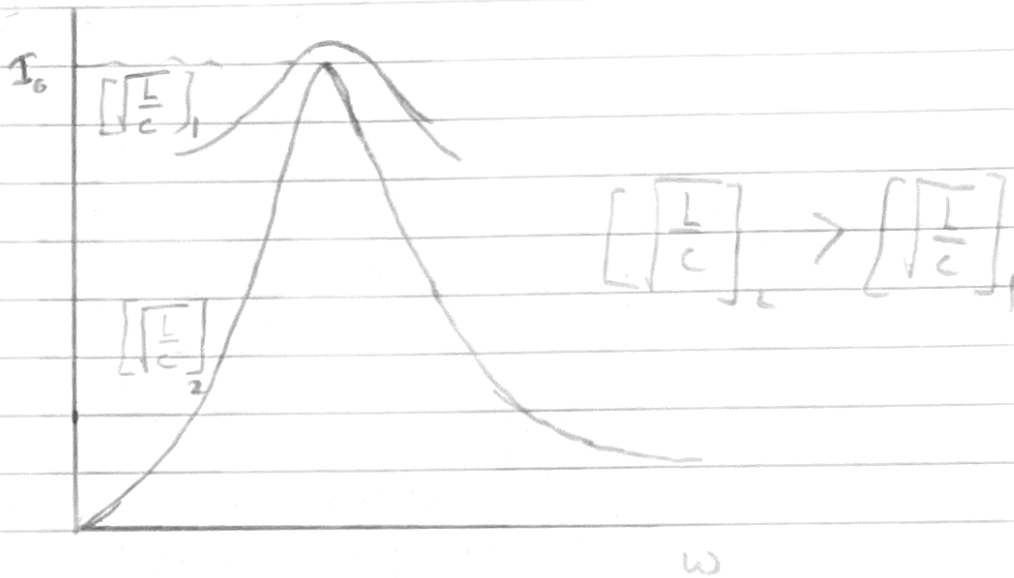
$$\left[\sqrt{\frac{L}{C}}\right]_2 > \left[\sqrt{\frac{L}{C}}\right]_1 \implies Q_2 > Q_1$$

In fact from the sharpness we know that

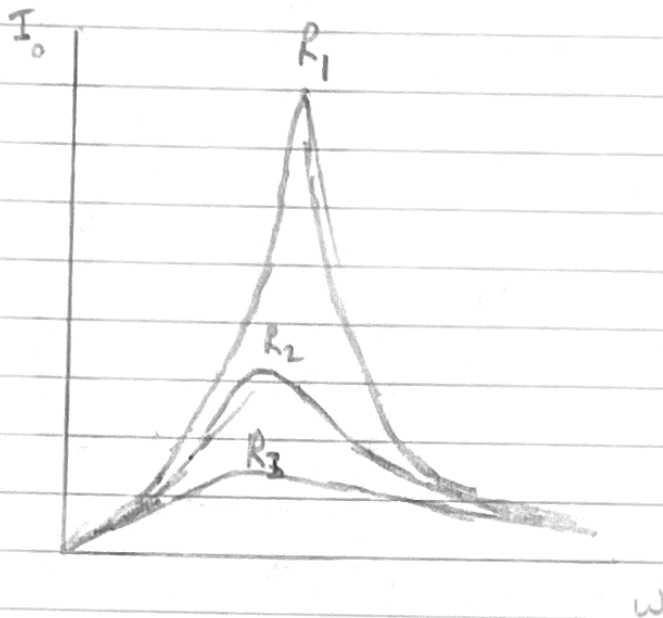$$Q_2 > Q_1 \quad \text{so that} \quad \left[\sqrt{\frac{L}{C}}\right]_2 > \left[\sqrt{\frac{L}{C}}\right]_1$$

سماء. قذ,

$$Q \frac{1}{\alpha} R \implies Q \text{ is inversely proportional to } R$$

or $Q \propto \dfrac{1}{R}$ sharpness كل ما Q قلت كل ما R زادت كل

$$Q_1 > Q_2 > Q_3$$
$$\implies R_3 > R_2 > R_1$$

$X_L = X_C \implies WL = \dfrac{1}{WC} \implies W_0 = \dfrac{1}{\sqrt{LC}}$

$f_0 = \dfrac{1}{2\pi \sqrt{LC}}$