1. 8.27 *RLC parallel circuit* **

A 1000 ohm resistor, a 500 picofarad capacitor, and a 2 millihenry inductor are connected in parallel. What is the impedance of this combination at a frequency of 10 kilocycles per second? At a frequency of 10 megacycles per second? What is the frequency at which the absolute value of the impedance is greatest?

解: 由并联关系可知 $\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}$

$Z_1 = R \quad Z_2 = i\omega L \quad Z_3 = \frac{1}{i\omega C}$

当 $\omega = 10\,kHz$ 时 $|Z| = 20.0\,\Omega$

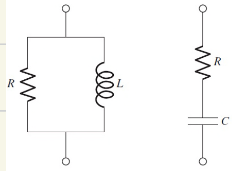
当 $\omega = 10\,MHz$ 时 $|Z| = 198\,\Omega$

$\frac{1}{Z} = \frac{1}{R} + i(\omega C - \frac{1}{\omega L})$

当 Z 最大时 $\frac{1}{Z}$ 最小 当 $\omega = 0$ 时阻抗最大.

2\. 8.30 *Equal impedance?* *

Do there exist values of R, L, and C for which the two circuits in Fig. 8.38 have the same impedance? (The resistor R has the same value in both.) Can you give a physical explanation why or why not?



解： $\frac{1}{Z_1} = \frac{1}{R} + \frac{1}{i\omega_1 L}$ $\qquad \frac{1}{Z_1} = \frac{1}{R} - \frac{i}{\omega_1 L}$ $\qquad \frac{1}{\frac{1}{R} - \frac{1}{\omega_1 L} i}$ $\qquad \frac{1}{(a-bi)} = \frac{a+bi}{a^2+b^2}$

$a-bi$

$Z_2 = R + i\frac{1}{\omega_2 C}$

令 $|Z_1| = |Z_2|$ 得 $\qquad \frac{\frac{1}{R}}{(\frac{1}{R})^2 + (\frac{1}{\omega_1 L})^2} = R \qquad \frac{\frac{1}{\omega_1 L}}{(\frac{1}{R})^2 + (\frac{1}{\omega_1 L})^2} = \frac{1}{\omega_2 C}$ 无解. 不符合题意

即不存在 R.L.C 使得二者阻抗相等。

左图为电阻与电感并联，总阻抗小于电阻阻抗.

右图为电阻与电容串联，总阻抗大于电阻阻抗.

二者电阻相等. 则不存在 R.L.C 使得二者阻抗相等.

3. 8.38 *Two resistors and a capacitor* **

The circuit in Fig. 8.42 has two equal resistors R and a capacitor C. The frequency of the emf source, $\mathcal{E}_0 \cos \omega t$, is chosen to be $\omega = 1/RC$.

(a) What is the total complex impedance of the circuit? Give it in terms of R only.

(b) If the total current through the circuit is written as $I_0 \cos(\omega t + \phi)$, what are I_0 and ϕ?

(c) What is the average power dissipated in the circuit?

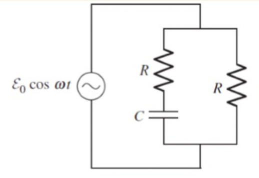


Figure 8.42.

解：(a). 由并联关系 $\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2}$

$Z_1 = R + i\frac{1}{wC} = R + iR$

$Z_2 = R$

得 $Z = \frac{3}{5}R + i\frac{1}{5}R$

(b). $\tilde{I}(t) = I_0 e^{i(wt+\varphi)}$ $\quad \tilde{V} = \mathcal{E}_0 e^{iwt}$

$\tilde{I}(t) = \frac{\tilde{V}}{Z} = \frac{\sqrt{10}\,\mathcal{E}_0}{2R} e^{i(wt - \tan^{-1}\frac{1}{3})}$

则 $I_0 = \frac{\sqrt{10}\,\mathcal{E}_0}{2R}$ $\quad \varphi = -\tan^{-1}\frac{1}{3}$

(c). $\bar{P} = \frac{1}{2}\mathcal{E}_0 \frac{\sqrt{10}\,\mathcal{E}_0}{2R} \cdot \frac{3}{\sqrt{10}}$

$= \frac{3\mathcal{E}_0^2}{4R}$