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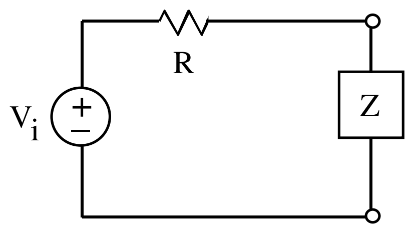
EX: a) Explain what single-resonant circuit to use in the box marked Z to make the voltage across Z a minimum at a specified frequency, ω_g.

b) Explain what single-resonant circuit to use in the box marked Z to make the voltage across Z a maximum at a specified frequency, ω_g.



ANS: a) L in series with C

b) L in parallel with C

SOL'N: a) The voltage across Z is given by the voltage divider formula:

$$H(j\omega) \equiv \frac{\mathbf{V}_o}{\mathbf{V}_i} = \frac{z}{R+z}$$ where z is impedance in box

We want $|H(j\omega)| = 0$ for specified ω_g. So we want $z = 0$ at ω_g.

For L in series with C, we have $z = j\omega L + -j/(\omega C)$. $z = 0$ at

$$\omega_o = \frac{1}{\sqrt{LC}}.$$

In other words, the series LC looks like a wire at resonant frequency.

We set $\omega_o = \omega_g$, or $LC = 1/(\omega_o)^2$.

b) The voltage across Z is given by the voltage divider formula:

$$H(j\omega) \equiv \frac{\mathbf{V}_o}{\mathbf{V}_i} = \frac{z}{R+z}$$ where z is impedance in box

We want $|H(j\omega)|$ = as large as possible for specified ω_g. The solution is to set $z = \infty$ (or $1/z = 0$) at ω_g.

For L in parallel with C, we have $1/z = 1/(j\omega L) + j\omega C$. $1/z = 0$ at

$$\omega_o = \frac{1}{\sqrt{LC}}.$$

In other words, the parallel LC looks like an open circuit at resonant frequency.

We set $\omega_o = \omega_g$, or $LC = 1/(\omega_o)^2$. Note: the same values of L and C will work for both cases. The difference between the two cases is the configuration of the L and C.