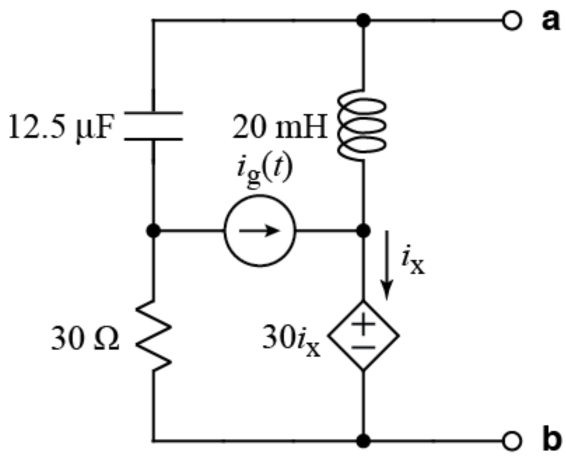
Homework 19

1.

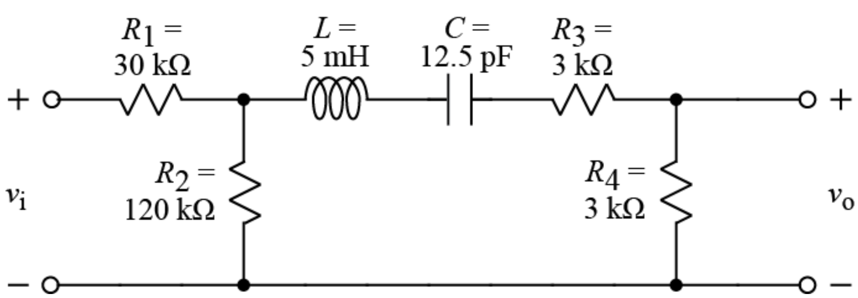


$$i_g(t) = 20\cos(2\text{k}t) \text{ A}$$

Draw a frequency-domain equivalent of the above circuit. Show a numerical phasor value for $i_g(t)$, and show numerical impedance values for R, L, and C. Label the dependent source appropriately.

2. Find the Thevenin equivalent (in the frequency domain) for the above circuit relative to terminals **a** and **b**. Give the numerical phasor value for $\mathbf{V}_{Th}$ and the numerical impedance value of z_{Th}.

3.



The above circuit is part of a simple crossover network for driving a midrange speaker having an impedance of 8Ω. The circuit is described at the following web site: http://www.termpro.com/articles/xover2.html. A more in-depth discussion of crossover networks may be found at http://sound.westhost.com/lr-passive.htm.

a) The above is what type of filter? (choose one of the following)

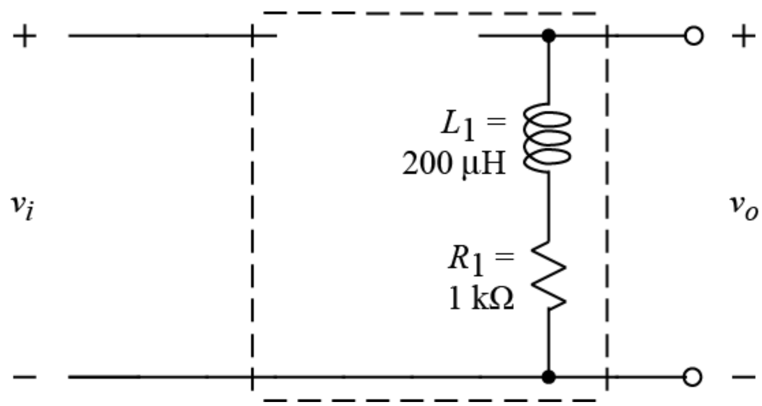
band-pass   band-reject

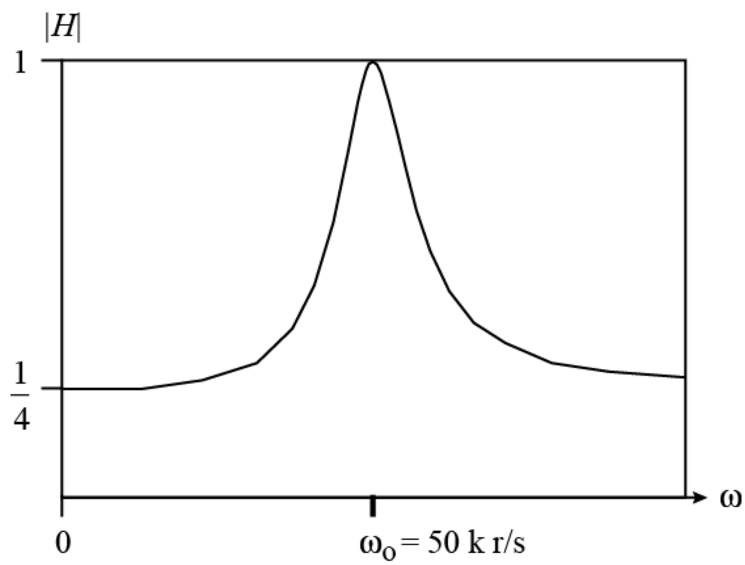
b) Find the center frequency, ω_o, of the above filter.

4. a) Find the maximum value of the gain, $|H(j\omega)|$, of the above filter.

b) Find the cutoff frequencies, ω_{C1} and ω_{C2}, of the above filter.

5.





Given the resistor and inductor connected as shown with the following values,

$R_1 = 1\ \text{k}\Omega$ $\qquad\qquad$ $L_1 = 200\ \mu\text{H}$

and using not more than an additional one each R, C, and L in the dashed-line box, design a circuit to go in the dashed-line box that will produce the **band-pass** $|H(j\omega)|$ vs. ω shown above. That is:

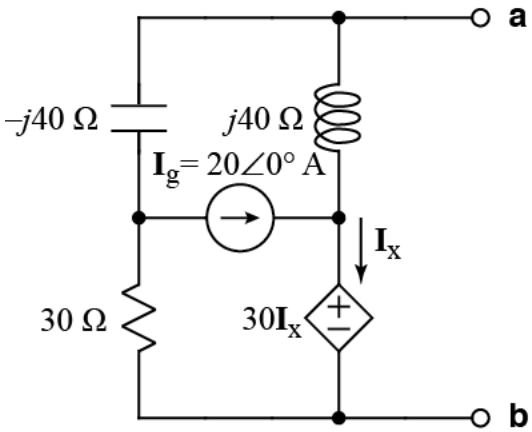
$$\max_{\omega} |H(j\omega)| = 1 \text{ and occurs at } \omega_0 = 50 \text{ k r/s}$$

$$|H(j\omega)| = \frac{1}{4} \text{ at } \omega = 0 \qquad \text{and} \qquad \lim_{\omega \to \infty} |H(j\omega)| = \frac{1}{4}$$

Specify values of R, C, and/or L, and show how they would be connected in the circuit. Note that a bandwidth is not specified, and you do not have to satisfy any more than the three requirements specified above.

Answers:

1.



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2. $\mathbf{V}_{\text{Th}} = -j800\,\text{V}$, $z_{\text{Th}} \approx 41.67\,\Omega$

3.a) **band-pass** b) $\omega_{\text{o}} = 4\,\text{Mr/s}$

4.a) $|H(j\omega)| = 0.08$ b) $\omega_{C1} = 2\,\text{Mr/s}$ and $\omega_{C2} = 8\,\text{Mr/s}$

5.