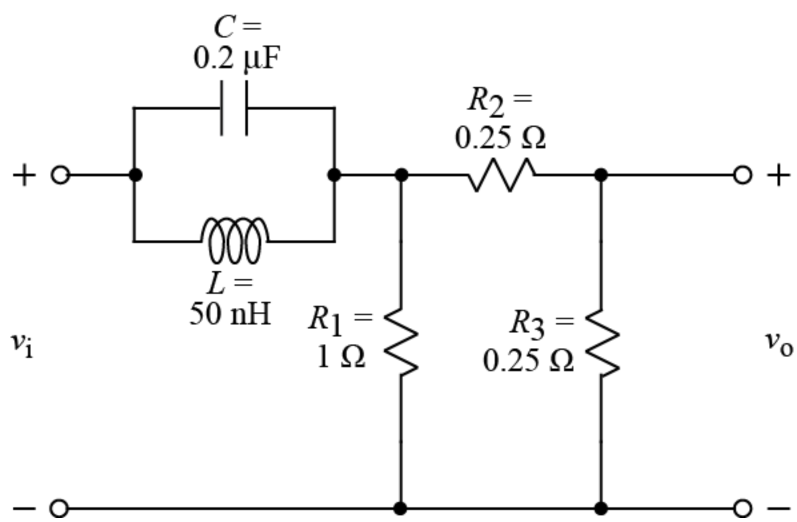
Ex:



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

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

SOL'N: a) The center frequency occurs when the impedances of the *L* and *C* cancel out. This occurs at the resonant frequency.

$$\omega_o = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.2\mu \cdot 50\text{n}}}\text{r/s} = \frac{1}{\sqrt{10\mu\text{n}}}\text{r/s} = \frac{1}{\sqrt{10\text{kn}^2}}\text{r/s}$$

or

$$\omega_o = \frac{1}{\sqrt{(100\text{n})^2}}\text{r/s} = \frac{1}{100\text{n}}\text{r/s} = 10\,\text{Mr/s}$$

b) If we took our output from just to the right of the *L* and *C*, (call this output v_1), we would have a standard *RLC* filter where the *R* would be the combination of the *R*'s:

$$R_{eq} = R_1 \,||\, (R_2 + R_3) = 1 \,||\, 0.5\,\Omega = \frac{0.5}{1+0.5}\Omega = \frac{1}{3}\Omega$$

The cutoff frequencies for a filter with v_1 as output would be given by the following standard formula for an *RLC* filter with a parallel *LC*:

$$\omega_{C1,C2} = \pm\frac{1}{2R_{\text{eq}}C} + \sqrt{\left(\frac{1}{2R_{\text{eq}}C}\right)^2 + \frac{1}{LC}}$$

or

$$\omega_{C1,C2} = \pm\frac{1}{\frac{0.4\mu}{3}} + \sqrt{\left(\frac{1}{\frac{0.4\mu}{3}}\right)^2 + \frac{1}{50\text{n}\cdot 0.2\mu}}\ \text{r/s}$$

or

$$\omega_{C1,C2} = \pm 7.5\text{M} + \sqrt{(7.5\text{M})^2 + (10\text{M})^2}\ \text{r/s}$$

or

$$\omega_{C1,C2} = \pm 7.5\text{M} + 1.25\text{M}\,\text{r/s} = 5\,\text{Mr/s and } 20\,\text{Mr/s}$$

Although the transfer function for v_o as the output is half the transfer function for v_1 as the output (because of the voltage divider consisting of the two 0.25 Ω resistors), the cutoff frequencies will be the same as above. The waveform at v_o is half as large, but so will be the maximum of its transfer function. Also, the voltage divider contains no reactive components and does not have any requency dependence. Thus, the cutoff frequencies are as computed above.