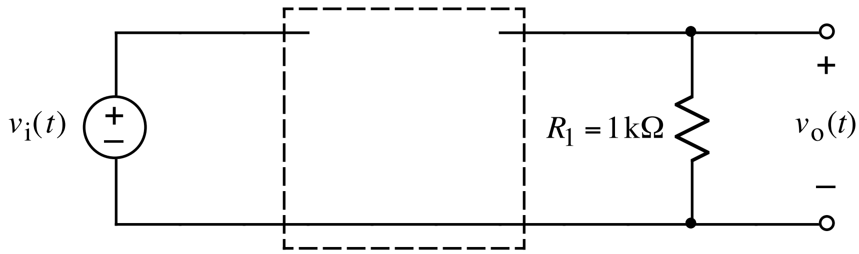
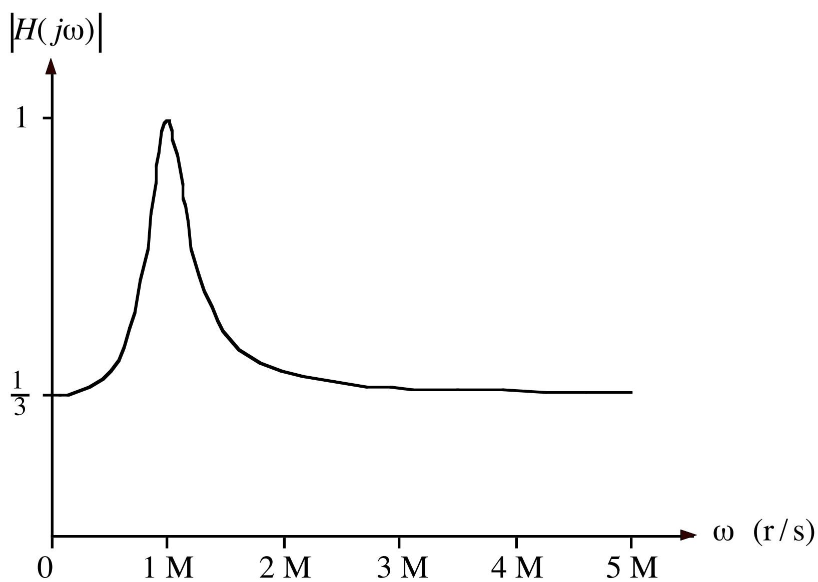
HOMEWORK #4

1.





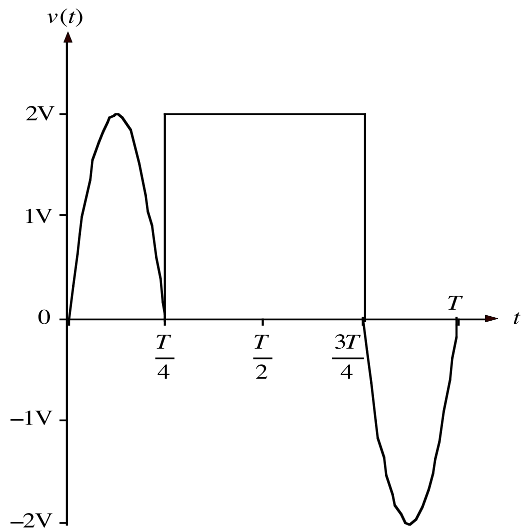
Given the resistor connected as shown and using not more than one each R, L, and C in the dashed-line box, design a circuit to go in the dashed-line box that will produce the **band-pass** $|H(j\omega)|$ vs. ω shown above. That is:

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

$$|H(j\omega)| = \frac{1}{3} \text{ at } \omega = 0 \qquad \text{and} \qquad \lim_{\omega \to \infty} |H(j\omega)| = \frac{1}{3}$$

If you use a C in your solution, use C = 0.5 nF.

2.



One period, T, of a function $v(t)$ is shown above. The formula for $v(t)$ is

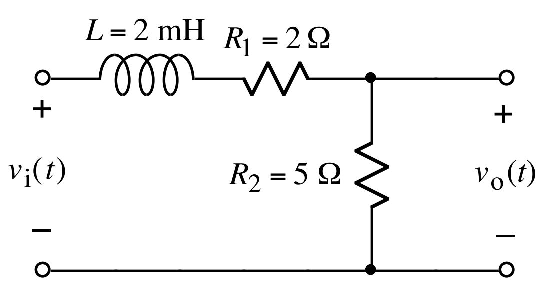
$$v(t) = \begin{cases} 2\sin\left(\frac{4\pi}{T}t\right)\text{ V} & 0 < t < T/4 \\ 2\text{V} & T/4 < t < 3T/4 \\ 2\sin\left(\frac{4\pi}{T}t\right)\text{ V} & 3T/4 < t < T \end{cases}$$

Find the numerical value of the following coefficients of the Fourier series for $v(t)$: (Hint: separate the function into even and odd parts.)

a) a_v b) a_1

3. Find the value of b_2 and a_4 for the Fourier series in problem 2.

4.



For the above circuit, determine the transfer function $H(j\omega) = V_o/V_i$.

5. Assume the circuit in problem 4, has the following input signal:

$$v_i(t) = 8 + \sum_{k=1}^{\infty} \frac{36}{k^2}\left[(2k-1)\cos(k\omega_0 t) - 2\sin(k\omega_0 t)\right] \text{ V}$$

Note: $\omega_o = 2$ k rad/s for the Fourier series.
Write the time-domain expression of the sixth harmonic (i.e., $k = 6$) of $v_o(t)$.