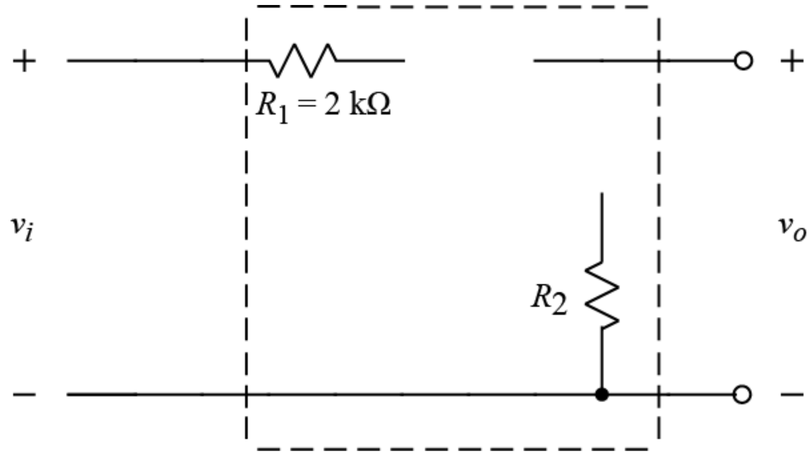
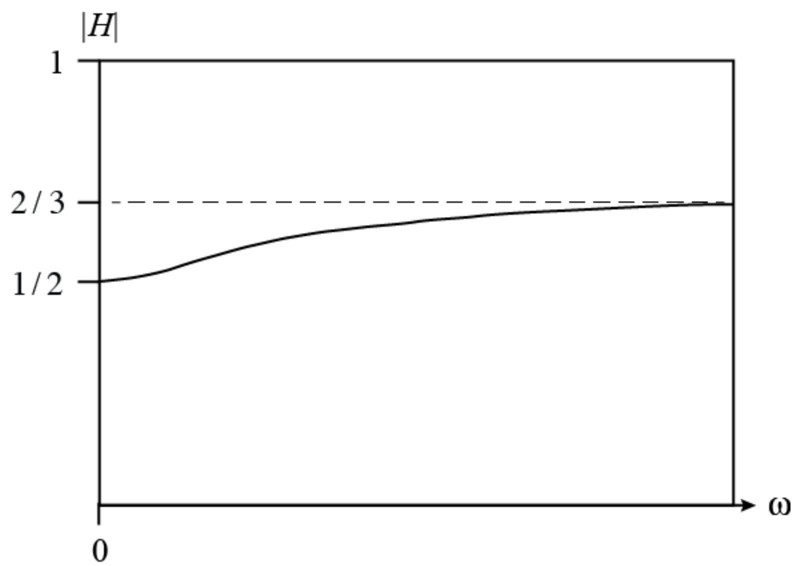
EXAM #4 prob 3 solution

Ex:





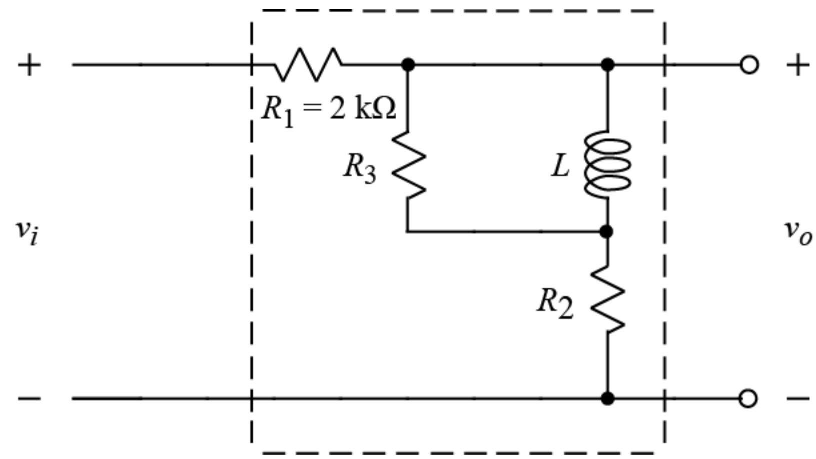
Given the resistors connected as shown, with R_1 = 2 kΩ, and using not more than an additional one each *R*, *C*, and *L* in the dashed-line box, design a circuit to go in the dashed-line box that will produce the |H(*j*ω)| vs. ω shown above. That is:

$$|H(j\omega)| = \frac{1}{2} \text{ at } \omega = 0 \qquad \text{and} \qquad \lim_{\omega\to\infty} |H(j\omega)| = \frac{2}{3}$$

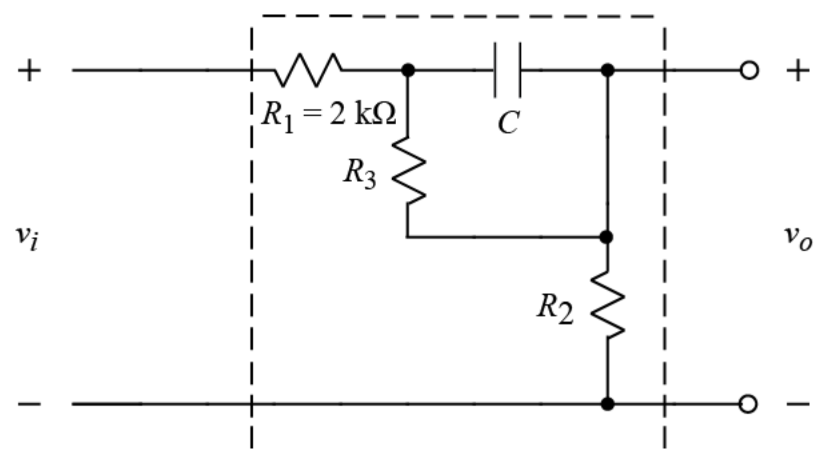
a) Show how the components would be connected in the circuit by drawing them in the box above. **Note:** component *values* are not required for this part.

b) Give the value of R_2.

SOL'N: a) This problem may be solved by using a single R and L in the configuration shown below:



This problem may also be solved by using a single R and C in the configuration shown below.



One or more solutions may be possible that include both an L and C, although these filters are likely to have ripples in the gain curve.

b) The value of R_2 will depend on the configuration used in part (a). For the solution with the R and L above, the value of R_2 is dictated by the gain at $\omega = 0$, since the L shorts out R_3 at this frequency.

$$\frac{R_2}{R_1 + R_2} = \frac{1}{2} \Rightarrow R_2 = 2\,\text{k}\Omega$$

The value of R_3 for this configuration would be 2 kΩ. (L becomes an open as ω approaches infinity, so there is a voltage divider formed by R_1, R_2, and R_3.)

For the solution with the R and C above, the value of R_2 is dictated by the gain for ω -> ∞, since the C shorts out R_3 at this frequency.

$$\frac{R_2}{R_1 + R_2} = \frac{2}{3} \;\Rightarrow\; R_2 = 4\,\text{k}\Omega$$

The value of R_3 for this configuration would be 2 kΩ. (C becomes an open for $\omega = 0$, so there is a voltage divider formed by R_1, R_2, and R_3.)