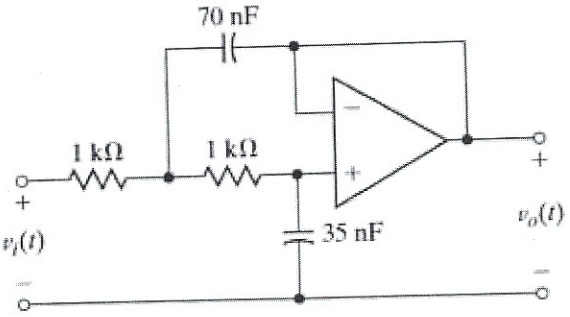
EE103 Fall 2017 Quiz 8 Dec. 4, 2017 Solution

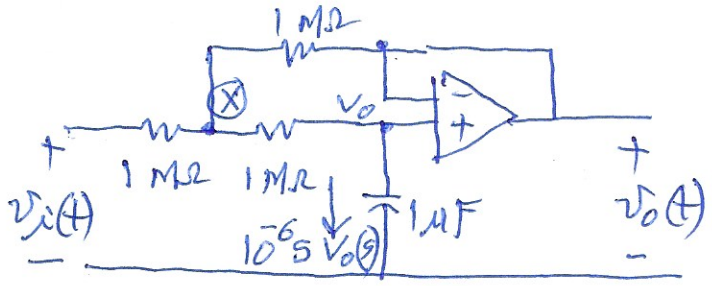
Name_____ ID_____

This problem is to test your ability for finding H(s) and output volatge for a given input voltage by using the Laplace Transform method.

Let us modify the same circuit you have studied below:



(a).(2 points) Redraw the circuit by changing 1KΩ resistors to 1MΩ resistors and 35nF capacitor to 1μF and 70nF capacitor to 1MΩ. (The circuit becomes a first order filter with only one capacitor.)



(b). (4 points) Find H(s)=Vo(s)/Vi(s)

$$V_i(s) = 10^6\left[10^{-6}s V_o + 10^{-6}\left(V_{\otimes} - V_o\right)\right] + V_{\otimes} \quad (1)$$

$$V_{\otimes} = 10^6 \times 10^{-6} s V_o(s) + V_o \quad (2)$$

From (1) & (2)

$$V_i(s) = sV_o + sV_o(s) + sV_o(s) + V_o(s)$$
$$= (3s+1)V_o(s)$$

$$\frac{V_o(s)}{V_i(s)} = \frac{1}{3s+1} = \frac{\frac{1}{3}}{s+\frac{1}{3}} = H(s)$$

(ans)

(c). (4 points) Find vo(t) for a step input u(t). Assume zero initial condition.

$$V_o(s) = H(s)\,V_i(s) = \frac{\frac{1}{3}}{s+\frac{1}{3}}\cdot\frac{1}{s}$$

$\mathcal{L}\,u(t) = \frac{1}{s}$

$$= \frac{-1}{s+\frac{1}{3}} + \frac{1}{s}$$

$$v_o(t) = \left(1 - e^{-\frac{1}{3}t}\right) u(t)$$

ans