

## ES 250 Practice Final Exam

1. Given that

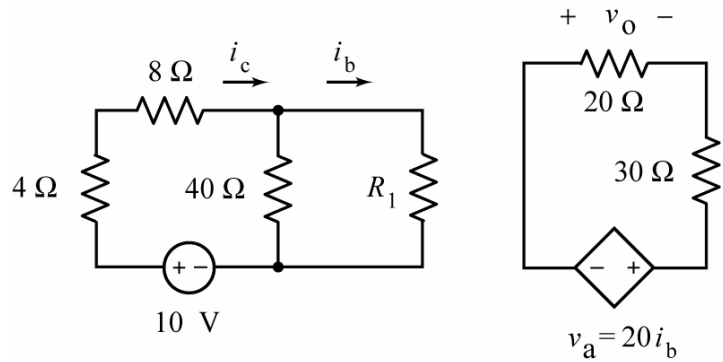
$$v_a = 8 \text{ V},$$

Determine the values of  $R_1$  and  $v_o$ :

$$R_1 = \underline{\hspace{2cm}} \Omega,$$

and

$$v_o = \underline{\hspace{2cm}} \text{ V}$$

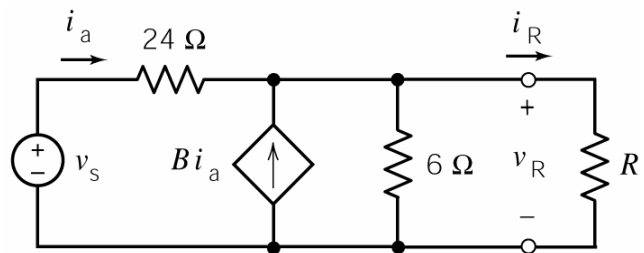


2. Given that  $0 \leq R \leq \infty$  in this circuit, consider these two observations:

When  $R = 2 \Omega$  then  $v_R = 4 \text{ V}$  and  $i_R = 2 \text{ A}$ .

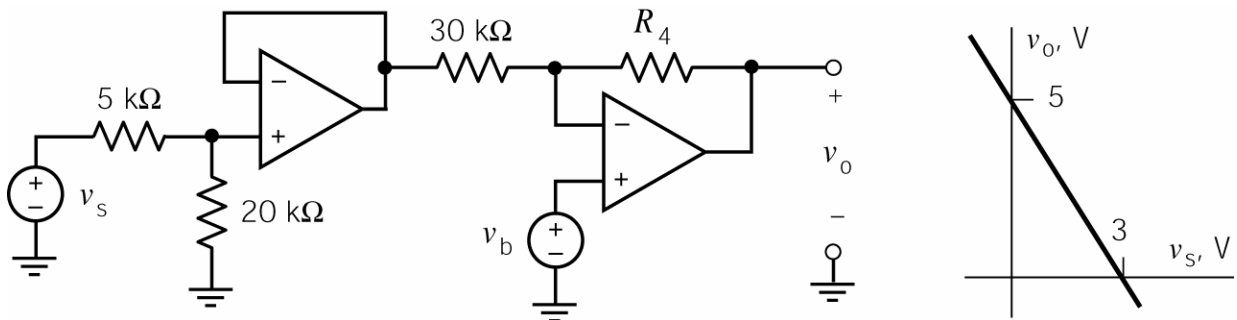
When  $R = 6 \Omega$  then  $v_R = 6 \text{ V}$  and  $i_R = 1 \text{ A}$ .

Fill in the blanks in the following statements:



- The maximum value of  $i_R$  is \_\_\_\_\_ A.
- The maximum value of  $v_R$  is \_\_\_\_\_ V.
- The maximum value of  $p_R = i_R v_R$  occurs when  $R =$  \_\_\_\_\_  $\Omega$ .
- The maximum value of  $p_R = i_R v_R$  is \_\_\_\_\_ W.

3.

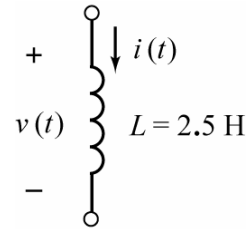


The input to this circuit is the voltage,  $v_s$ . The output is the voltage  $v_o$ . The voltage  $v_b$  is used to adjust the relationship between the input and output. Determine values of  $R_4$  and  $v_b$  that cause the circuit input and output have the relationship specified by the graph

$$v_b = \underline{\hspace{2cm}} \text{ V and } R_4 = \underline{\hspace{2cm}} \text{ k}\Omega.$$

4. Consider this inductor. The current and voltage are given by

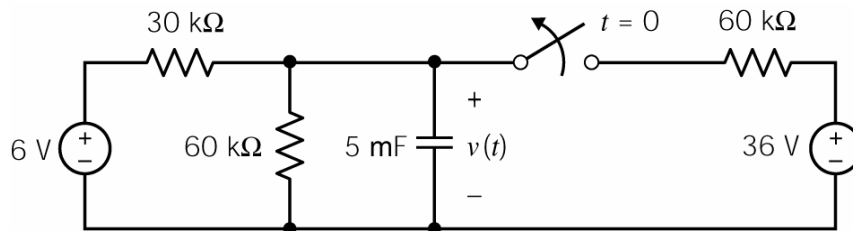
$$i(t) = \begin{cases} 5t - 4.6 & 0 \leq t \leq 0.2 \\ at + b & 0.2 \leq t \leq 0.5 \\ c & t \geq 0.5 \end{cases} \quad \text{and} \quad v(t) = \begin{cases} 12.5 & 0 < t < 0.2 \\ 25 & 0.2 < t < 0.5 \\ 0 & t > 0.5 \end{cases}$$



where a, b and c are real constants. (The current is given in Amps, the voltage in Volts and the time in seconds.) Determine the values of the constants:

$$a = \text{_____ A/s}, \quad b = \text{_____ A} \quad \text{and} \quad c = \text{_____ A}$$

5. This circuit is at steady state when the switch opens at time  $t = 0$ .



The capacitor voltage is  $v(t) = A - Be^{-at}$  for  $t \geq 0$ . Determine the values of the constants A, B, and a:

$$A = \text{_____ V}, \quad B = \text{_____ V} \quad \text{and} \quad a = \text{_____ s}.$$

6. This circuit is at steady state before the switch closes at time  $t = 0$ . After the switch closes, the inductor current is given by

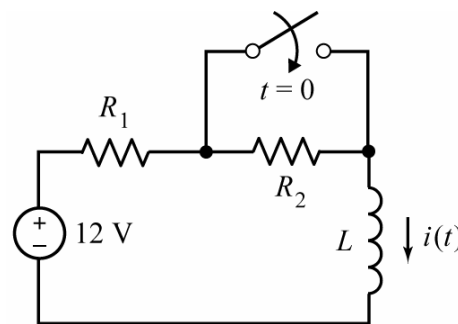
$$i(t) = 0.6 - 0.2e^{-5t} \text{ A} \quad \text{for } t \geq 0$$

Determine the values of  $R_1$ ,  $R_2$  and  $L$ :

$$R_1 = \text{_____ } \Omega, \quad R_2 = \text{_____ } \Omega$$

and

$$L = \text{_____ H}$$

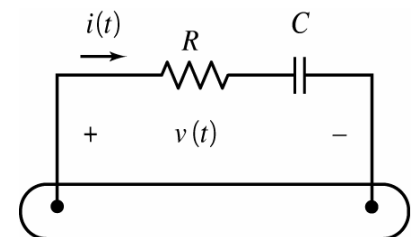


7. The voltage and current for this circuit are given by

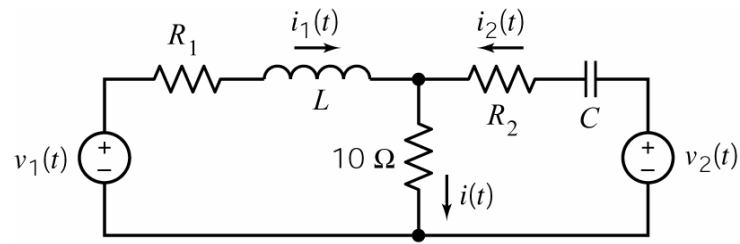
$$v(t) = 20 \cos(20t + 15^\circ) \text{ V} \quad \text{and} \quad i(t) = 1.49 \cos(20t + 63^\circ) \text{ A}$$

Determine the values of the resistance, R, and capacitance, C:

$$R = \text{_____ } \Omega \quad \text{and} \quad C = \text{_____ mF}.$$



8.



This circuit is at steady state. The voltage source voltages are given by

$$v_1(t) = 12 \cos(2t - 90^\circ) \text{ V} \quad \text{and} \quad v_2(t) = 5 \cos(2t + 90^\circ) \text{ V}$$

The currents are given by

$$i_1(t) = 744 \cos(2t - 118^\circ) \text{ mA}, \quad i_2(t) = 540.5 \cos(2t + 100^\circ) \text{ mA} \quad \text{and} \quad i(t) = A \cos(2t - 164^\circ) \text{ mA}$$

Determine the values of  $A$ ,  $R_1$ ,  $R_2$ ,  $L$  and  $C$ :

$$A = \text{_____ mA}, \quad R_1 = \text{_____ } \Omega, \quad R_2 = \text{_____ } \Omega, \quad L = \text{_____ H} \quad \text{and} \quad C = \text{_____ mF}.$$